

Project and Procurement Method Selection in the Context of Portfolio Consideration
and Financial Constraints

by

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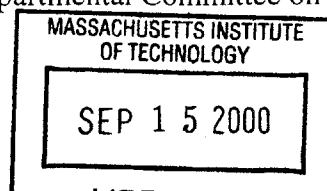
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ABSTRACT

Current trends in the construction industry show that owners/clients are trying to procure a project in the least amount of time and the least amount of costs. From the owner's/client's point of view, this is especially necessary in the context of the decreasing amount of available capital and the increasing number of projects. Furthermore, the owner/client is confronted with an existing portfolio, which needs to be maintained, repaired, improved, and/or renewed. In order to be able to reduce cost and time the use of alternative delivery methods and financing strategies needs to be considered. For the owner/client a method should exist, which can aid him in choosing appropriate delivery methods for the projects under the given circumstances. In addition, help needs to be provided for choosing a combination of projects, which is able to satisfy the owner's/client's need for improving the overall quality of the portfolio.

Over the last couple years, various methods have been established in order to give the owner/client assistance in choosing an appropriate delivery method for a project. These methods however do not consider important factors the owner/client has to manage such as portfolio, budget, and life cycle considerations.

This thesis will modify and extend an existing methodology and will take into account the factors of portfolio, budget, and life cycle. This will result in a method, which the owner/client can use in order to choose appropriate delivery and financing methods based on project, owner, business, and construction market drivers and a wise combination of projects based on portfolio and budget considerations. This will aid the owner/client to reach an improvement in the quality of the portfolio under the known resource constraint.

Thesis Supervisor: John B. Miller

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1 Introduction

1.1 Objectives

Public and private owners/clients continuously need to provide, rehabilitate, and replace infrastructure facilities and services under circumstances of capital constraints. Generally, a predetermined procurement and financing strategy has been used by the public sector in most Western countries. This predetermined strategy is Design-Bid-Build requiring to procure all phases of delivering a project separately. A variety of projects are typically planned and delivered to meet infrastructure needs, not only new construction projects, but also repair, improvement, and replacement projects. All these different types compete for a piece of the pie, the capital that is available to both public and private owners to allocate to infrastructure.

This thesis focuses on the notions that owners/clients must start to think about the entire portfolio when making infrastructure decisions. As multiple project delivery and finance methods continue to emerge, so too will the goal of improving the overall quality of the portfolio, its cost performance, and the overall level of service.

To reach these goals, owners/clients and producers must keep ahead of the evolutions of different delivery and financing strategies. The hypothesis of this thesis is that three factors will become critical to succeed in infrastructure management: portfolio considerations, financing and delivery options in the procurement process, and project life cycle.

Subsidiary objectives of this thesis include:

- (1) an explanation of the importance of the infrastructure portfolio throughout the procurement process,
- (2) an identification of alternative approaches to overcome financial constraints by structuring projects to be attractive to private producers, and

- (3) an explanation of different delivery and financing strategies and how they might be used simultaneously to further broad societal needs.

The thesis concludes, in Chapter 6, with a proposed methodology for assessing delivery choice and financing options to improve infrastructure portfolios.

1.2 Necessity for Project and Procurement Method Selection Process

Over the last few years, owners/clients have realized that their desire to procure projects is more and more restricted by the shortage of available resources.

This shortage is not only the result of less available capital (Miller 2000) but also of the increase in the number of projects, especially reconstruction projects (McKim et al. 2000). The projects in this context are not only new construction projects, but also repair, replacement, and improvement projects. In short, resources decrease for an increase in projects.

Currently, the collection of assets cannot be maintained and repaired as it needed to be and new projects are costly and often neither within schedule nor within budget.

In addition, owners/clients have followed the strategy of procuring a project either when the owner/client decided that the project was necessary or if funding from an outside source was available such as the Construction Grants Program (CGP) of the US Environmental Protection Agency (EPA) or the Interstate Highway System Program (IHS) of the US Department of Transportation (DOT) in the public sector, which only support certain kinds of projects. Examples are the procurement of wastewater treatment plants and rural interstate highways in excess of demand at the time these programs were introduced (Miller 2000).

Sometimes projects are procured although not absolutely necessary just because a proper assessment of the current asset was not available. On other occasions, the possibility to combine projects at one location, therefore saving cost and time, is not made use of because e.g. funding is only available for one of the projects.

This problem needs to be solved. Before making decisions about the most urgent projects, the owner/client has to evaluate the current condition of his portfolio – the collection of assets and their costs – and has to make a choice, which will improve the overall quality of the portfolio. In this context, the owner/client has to realize that a project has a certain effect on other projects, since this project will be procured and others cannot be procured due to the missing capital. This fact also demands for a wise decision about the way the project is procured.

The delivery method – the way a project is delivered to the owner/client – also plays a major part in the problem of the capital shortage.

Public owners/clients are required by regulations and statutes to use the so-called traditional method – Design-Bid-Build. Private owners/clients also use this method on a common basis. Often it is solely relied upon this method, not only in order to be able to use competitive market forces but also because owners/clients are familiar with this method and not familiar with alternatives. Furthermore, an owner/client often uses a certain delivery method because he is used to it, it appears to be easier, or it is suggested by the designer or contractor. But often an alternative delivery strategy may be better suited for the owner/client and the project than another.

The need for alternative strategies is especially fostered by five major trends in the construction industry: (a) project complexity: projects become more complex and sophisticated, therefore reflecting the change in society and general industry, (b) schedule crunch: owners/clients are on a tighter schedule and may not be able to make decisions until the last possible moment, (c) quality and value: owners/clients demand quality and value and recognize that value does not necessarily mean lowest price, (d) teamwork: the industry realizes the benefits of taking a teamwork approach with an early integration of the design and construction elements of a team and offering the owner/client a single point of responsibility, and (e) dispute resolution: owners/clients, designers, and contractors become aware of the disadvantages of litigious actions and are focusing on the success of the project as a whole (Mulvey 1997).

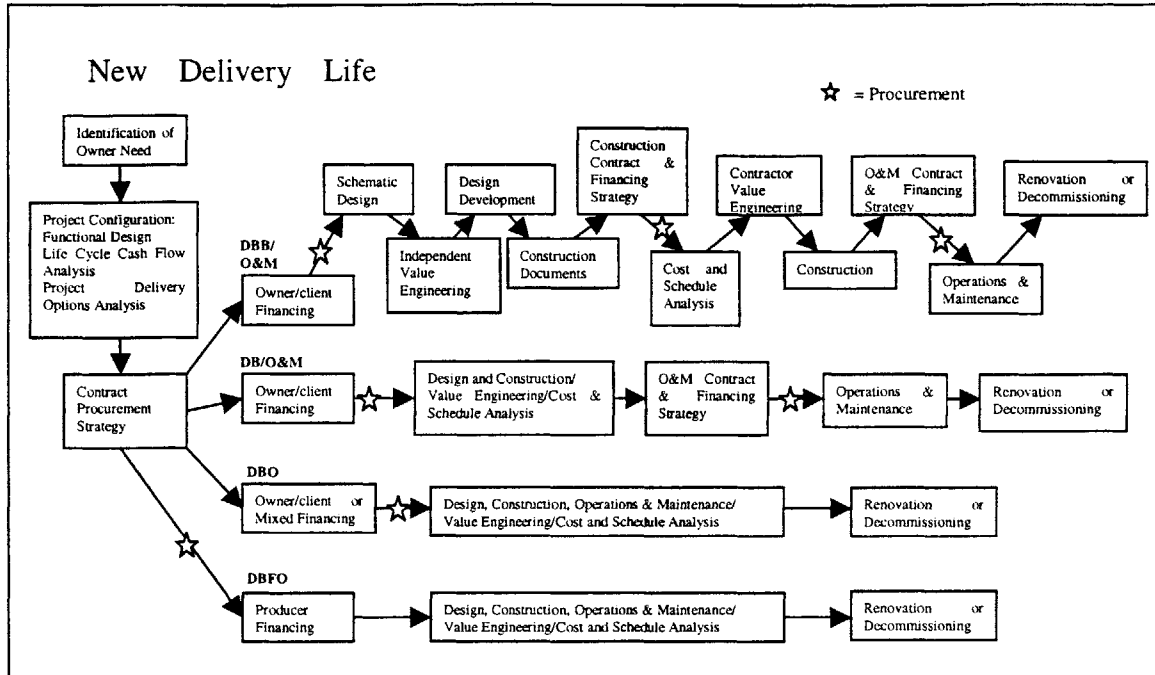
Over the last decade, private as well as public owners/clients have rediscovered the opportunities of alternative delivery strategies and financing options. This can provide the owner/client with an increase in the overall success of the project. Success in this case is defined as being within budget, within schedule, with the least number of change orders, rework, claims, and disputes, meeting the expected level of quality, and satisfying the various entities involved. It has been estimated that the choice of an appropriate delivery method can reduce overall costs by an average of 5% (Business Roundtable, 1982). Furthermore, it is important that the owner/client chooses a delivery method, which satisfies the technical features of the project as well as the owner's/client's and contractor's needs.

Although the alternative approaches to the delivery of projects – Construction Management, Design-Build, Turnkey, Design-Build-Operate (DBO), Design-Build-Finance-Operate (DBFO) – seem new to most owners/clients it has to be recognized that they were used throughout the history of the USA (Miller 2000).

For the owner/client a means to assist during the decision making process concerning an appropriate delivery method and for choosing a combination of projects under the capital constraint needs to exist in order to successfully procure a project and improve the quality of the portfolio. In order to reach the goal of a high quality portfolio, the owner/client should follow a distinct process – the new project life cycle (**Figure 1-1**), developed by Mahoney (1999). This includes that the owner/client needs to (a) identify a project need, (b) prepare a functional design, (c) prepare a cash flow analysis, and (d) conduct a project delivery option analysis before procuring the project.

In the last decade several methods have been established. But these consider only the design and construction phases of the project.

Figure 1-1 New Project Life Cycle



1.3 Thesis Structure

This thesis will offer the owner/client assistance during the process of choosing an appropriate delivery method for the proposed projects and a combination of projects to reach the owner's/client's goal concerning the portfolio.

Various models have been established in the past (Gordon 1991, 1994; Alhamzi and McCaffer 2000), which after reading lack the inclusion of portfolio, budget, and life cycle considerations.

This thesis attempts to modify and extend a method established by Gordon (1991, 1994). Gordon's methodology focuses on eliminating inappropriate delivery methods for a single project using what he calls a "driver" analysis. This thesis attempts to extend Gordon's single project analysis to a collection of projects, using portfolio and budget considerations.

Chapter 3 to 5 provide background for the new approach.

Chapter 3 focuses on the importance of portfolio considerations in the decision making process.

Chapter 4 focuses on the availability and use of different financing strategies.

Chapter 5 focuses on different project delivery strategies available to the owner/client. Some of the advantages and disadvantages of each are highlighted in the context of the new approach.

Chapter 6 presents my proposal for extending and expanding Gordon's methodology to portfolios of infrastructure projects. The methodology is divided into three sections. In the first section, inappropriate delivery methods are still eliminated on the basis of project, owner, business, and construction market drivers and a financial analysis. In the second section, the remaining delivery options are configured to explore different scenarios for the entire collection. The third section will provide assistance in selecting an appropriate contract and award method.

2 Definitions

Constructor – The business entity responsible for the construction phase of a project

Contractor – The business entity, which has a contractual relationship with the owner/client

Combined Delivery Strategy – The contractual combination of the design, construction, and operations and maintenance (O&M) phases of a project

Segmented Delivery Strategy – The contractual separation of the design, construction, and/or O&M of a project

Design-Bid-Build – Segmented design, construction, and O&M with a single business entity acting as the contractor in complete and sole charge of construction; directly financed through separate payment of each entity

Design-Build – The combination of design and construction with a single business entity acting as the contractor in complete and sole charge of these services; directly financed through separate payment of each entity

Design-Build-Finance-Operate – The combination of design, construction, and O&M with a single business entity acting as the contractor in complete and sole charge of these services; indirectly financed through transferring right to collect user charges as sole source of revenue, financial risk is held by the producer

Design-Build-Operate – The combination of design, construction, and O&M with a single business entity acting as the contractor in complete and sole charge of these services; directly financed either through payment for work performed, regular payment over the projects life cycle, transferring right to collect user charges, or combination of subsidy or capital incentive and/or transfer right to collect user charges

Designer – The business entity responsible for the design phase of a project

Producer – The business entity involved in a DBO or DBFO project

Direct Financing Strategy – Owner/client financial support of a project

Indirect Financing Strategy – Producer financial support of a project

Operator – The business entity responsible for the O&M phase of a project

Owner/client – The body within a company or Federal, state, or local government that initiates a project

Portfolio – The collection of physical assets and facilities initiated, controlled, or owned by the owner/client

3 Portfolio Analysis

3.1 Importance of the Portfolio

Before making decisions which projects will be undertaken, owners/clients need to look at the whole portfolio of current assets.

In the public sector the portfolio might consist of schools, prisons, highways, town streets, water treatment facilities, and other public buildings. In the private sector the portfolio might consist of manufacturing plants, office buildings, research facilities, and other physical assets.

The goal of every procurement should be to improve the quality of the whole portfolio, the level of service related to it, the cost performance, and the timeliness. In the private sector the expenditures need to produce improvements in the corporate performance including the development of new products and the activities related to it.

These goals can be easily reached if enough capital is available to fund the projects. But this is the source of the problem. Neither the public nor the private sector has an unlimited amount of resources available (Miller 1997; Miller 2000). Therefore, the goal for both sectors should be to produce the greatest benefit at this resource constraint.

Miller argues that, to improve the quality of an infrastructure portfolio, owners/clients need to focus on four important issues (Miller 2000).

(a) Expenditures are rarely known based on activity. If an activity based costing system is in place it can give rise to a knowledge about a good starting point to improve resulting in a decrease in costs, an increase in quality and the level of service. A proposed project needs to be measured against current costs to offer the owner/client the opportunity to evaluate if it can decrease the costs and increase the quality.

(b) Current condition of assets is rarely evaluated before deciding on projects. A condition assessment of current assets will offer the owner/client a means for a better calculation of future repair or replacement obligations. It will further stop the owner/client of decommissioning assets, which are perfectly well maintained and in good condition. Current and future repair projects compete with new projects as well as replacement projects for the limited amount of capital available.

(c) Procurement strategies need to be based on ten fundamental elements, established by Miller (2000). These elements are prerequisites for a successful procurement of projects in the context of the portfolio and the approval of the projects by taxpayers, users,

shareholders, etc. They are furthermore essential for procurements, where the private sector is invited to offer its services in connection with a DBO or DBFO procurement.

(d) Multiple delivery methods and financing options are rarely taken into consideration. In order to produce the greatest benefit for users, taxpayers, shareholders, owners/clients, etc. at the resource constraint the use of multiple delivery methods and different financing options should be evaluated and, if appropriate, applied. Each sector can contribute different complimentary strengths.

As time passes a reevaluation of the implemented strategy will become necessary and an assessment if the goals are met needs to be performed. Very likely a change in strategy will then become obligatory since new problems occur, others are solved, and again others become less important.

This is already well-known in the private sector (Macomber 1991). Corporations define their strategic goals on a yearly and a long-term basis. The defined long-term strategy usually is adjusted as new technology and innovation takes place and changes the face of the business.

3.2 Choice and Timing of Projects

In an ideal world of sufficient resources all projects could be procured at the time required.

Unfortunately, this ideal world does not exist. Public and private sectors are bound to a constraint on available capital.

In this context, the decision about the choice of a project and its timing becomes more difficult. There are certain issues, which relate to this problem.

The first issue is related to an activity based costing system. This system can, if implemented, reveal problems concerning the efficiency of operations. An improvement may offer dramatic savings and an increase in the quality of the project.

The second issue relates to the condition of the assets. If the current condition of owned assets is known, the owner/client will be able to evaluate the remaining useful life

and if the asset can meet future regulation changes. The condition assessment can reveal if an asset's efficiency can be improved by repair or if a replacement needs to be considered and if the current maintenance activities are sufficient to keep up with the required maintenance level.

In connection with choosing a project and its timing, decisions about the future strategy of the public sector or of a corporation to improve its portfolio need to be considered. These decisions especially relate to the competitive advantage the owner/client wants to attain.

All these topics need to be included in the decision about future projects.

4 Financial Constraints

4.1 Financial Constraints on Overall Portfolio

As already described in the prior part, the public and the private sector exist in an environment where neither sector has sufficient resources available to procure all the desired projects.

As these resources become less over the years the owners/clients have to employ a method which can help them to procure as many projects as possible. In the U.S., for example, capital appropriations from federal resources in the public sector have decreased nominal and as a percentage of the GDP and the number of projects has increased. This is the case due to the wear out of owned assets for which not enough capital is available to properly maintain and repair them as well as the increasing demand for new projects. Decisions about projects should not be made in the context of the probability of getting funding for a project by an external investor such as grants from the federal government in the case of the public sector. Moreover, the owner/client should focus on reaching its goal of producing the greatest benefit for the portfolio. This can be achieved by realizing that different financing options as well as delivery methods with distinct advantages can be employed.

The two different financing options are direct and indirect. The direct method assumes that the project is completely financed by the owner/client. This includes financing through own capital, user charges, or a mix of both. The indirect method assumes that the project is completely financed by the producer, who owns the right to collect user charges.

To be able to find out which financing strategy might be viable for a particular project two major issues need to be addressed. The first issue relates especially to the opportunity to attract the private sector to get involved in a project and provide its financing. The second issue relates to the owner/client side. The owner/client has to evaluate the project's characteristics concerning topics such as revenue generation and ownership.

4.2 Prerequisites for Attractiveness of Projects to the Private Sector

In order for the private sector to be attracted to and to get involved in the financing part of a project, the project needs to meet prerequisites.

Two major issues in this connection are: (1) the competitiveness and financial attractiveness of the proposed project, and (2) the attractiveness of the owner/client as the project defining entity. If these issues can be reasonably satisfied, an adequate environment for the private sector to get involved in the project is provided.

Before the owner/client decides on the financing strategy he will have to evaluate the different available options. The owner/client has to recognize that a project is not fixed and that it can be reconfigured. The evaluation includes a cash flow analysis of the proposed project and an analysis if alterations in the scope of work can change the number of viable financing strategies.

4.2.1 Project Attractiveness

There are some reasons why projects can be attractive to a producer. These relate to the financial side of the project and to the competitive advantage, which the producer can gain, if he is chosen for the project's delivery.

The financial side is important because a producer will only decide to completely finance a project without any owner/client participation if a method to generate revenue exists. This usually results in the contractual inclusion of the O&M phase.

In order to finance the design and construction phase the producer will need to raise a loan, issue bonds, and participate with own equity. During the O&M phase he will further have to pay for activities related to this phase, pay off debt, and pay shareholders and equity participants. After all these obligations are met, a reasonable profit margin for the producer should remain.

In order to meet all obligations, the O&M phase has to offer the possibility to generate revenue. In the case of the indirect financing option this revenue will be the sole source of financing for the needed expenditures. It has to be sufficient to completely financially support the project.

A project, where revenue can be generated, has to meet other prerequisites as well. Sufficient demand and a growth opportunity for this demand needs to exist. Usually successful projects hold some kind of monopoly, either created by geography or by regulatory conditions.

The private sector will also conduct a cash flow analysis over the life cycle of the project with the above elements included. Based on this analysis the producer will decide if it provides enough proof that the project is financially viable.

During the evaluation of the project's attractiveness the owner/client is able to either increase the scope of work and still offer a financially viable project or decrease the scope of work to make the project financially viable.

The other factor why a project can be attractive to a producer is the opportunity to earn a competitive advantage over other competitors.

If it wins it can gain competitive advantage by earning superior knowledge in that field. Future competitions might become easier. By getting involved in the competition for projects a private sector company might find a niche for future business. Competing for a

project can also offer the producer an opportunity to develop new systems or approaches to problems, which might be possible to be used in future competition.

4.2.2 Owner/Client Attractiveness

For a private producer to involve itself in projects of public or private owners/clients, the owner/client has to be aware of its responsibilities. He has the opportunity to make the project and its whole process attractive for the producer.

There are some key elements, which the owner/client needs to consider before and during the procurement process. These elements are further trying to improve the taxpayer's, user's, shareholder's, etc. acceptance of the project as well.

The elements are part of a set of "fundamental elements of American infrastructure in the twenty-first century" identified by Miller (2000).

In the context of an attractive owner/client, the following elements are important.

The owner/client needs to define the scope:

It is very important that the owner/client defines the scope so that strong signals can be sent to potential competitors that a project will be procured. Furthermore, the scope needs to show that technical as well as financial ability of the producer is important for the evaluation of the proposals, not a subjective satisfaction of needs. It is also important in the context of the high expenses of a proposal, which the proposer has to bear if not chosen.

A head-to-head competition needs to be conducted:

In order to get the best value and the best compliance with the scope, objective criteria need to be included in the Request for Proposal so that a competition can be conducted. Objective criteria will attract more competitors to the project.

All competitors need to be fairly treated:

Before competition commences and a contract is awarded, the rules under which the agreement is reached and the contract is performed need to be established and published. This will decrease the time and costs of the award process. It will also offer the competitors a level playing field and will signal them that it is worth it to encounter on a time consuming and costly proposal preparation process.

Transparency of the whole process needs to be given:

The producer needs to be able to see and understand the acquisition system, which is used during the procurement process. This will give him a better insight and will provide him with an opinion that it is worth it to commit to participation. The producer also has to be able to be sure that this system is then actually being implemented. This issue offers the producer a stable, reliable, and predictable environment.

The owner/client needs to be open to technological change:

In order to draw producers towards anticipating in a competition, it is important to signal that the owner/client is open to technological change. This will attract the private sector since they have the opportunity to include new technology and innovation in their proposals. Mostly, these innovations are towards higher efficiency of the construction and operations phase making the project also more interesting for the owner/client. For private producers having the chance to innovate for their clients can offer them a competitive advantage.

These five elements directly relate to the commitment the owner/client wants to show towards the project. Owner/client commitment is an important prerequisite and signals that he is willing to offer all parties a successful and positive situation.

In this context some cases show that a lack of owner/client commitment led to an unsuccessful procurement. One example is California's AB680 program. The California Department of Transportation had invited the private sector to propose projects from which four were to be chosen. In this case, the Department did not define the scope but let

the private sector choose a project on their own. More or less, this led to a single source procurement of four projects without competition. The Department had failed to commit itself to a certain project and had not signaled beforehand that any project was to be built. So far, only one of the four chosen proposals is procured.

But there are also positive cases, where the owner/client committed itself to the project and the process and reached its goal of successfully procuring a project. An example is a project procured by the City of Seattle, Washington State. In order to increase the reliability of the water supply a new water treatment facility was proposed. The City committed itself so far, that it defined the scope in a clear and verifiable manner and followed all of the above named elements including being open to technological change. Furthermore, it established a benchmark, which all proposals needed to beat by at least 15%. The winning proposal shows these savings as well as it offers an innovative design.

These examples show among other things, such as a successful application of alternative delivery strategies, that owner/client commitment is a necessity for procuring a successful project, which satisfies the goals of all involved parties.

5 Project Delivery and Financing Strategies

5.1 Background

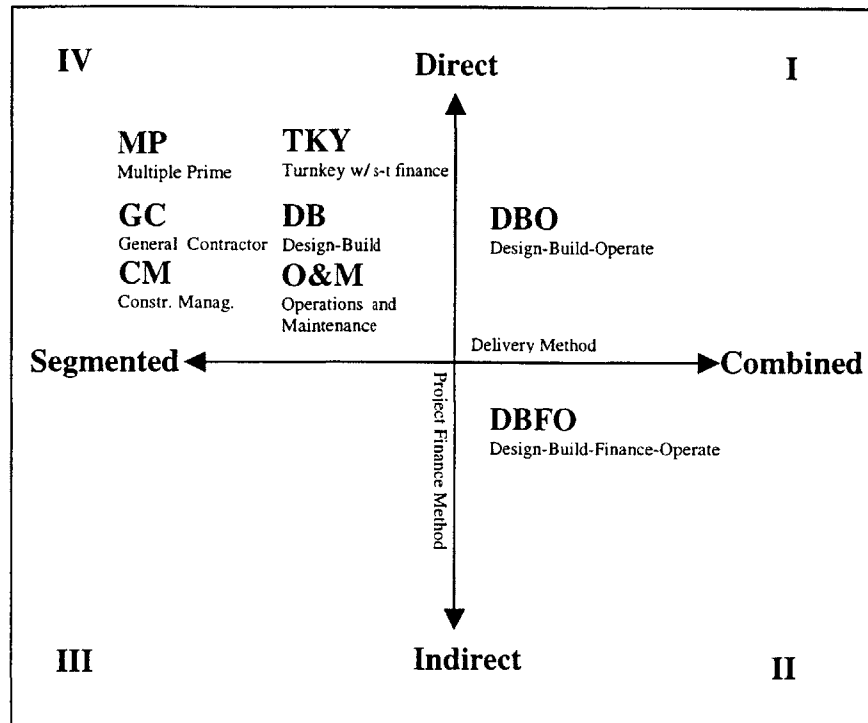
Since construction first started in the U.S. different delivery methods and financing options emerged to procure projects (Miller 2000).

The expression “delivery method” includes the functions of designing, building, operating, maintaining, and financing a project. Owners/clients can arrange for the delivery of projects through a variety of contract strategies. These functions can be separately purchased, or can be acquired in a single contractual arrangement.

A delivery method can be separated into the phases of the work and the financing strategy. Based on the interrelation the Quadrant Framework was developed by Prof. John Miller at MIT.

Figure 5-1 represents a version of the Quadrant Framework, which is modified to conform to the requirements of this thesis. A complete version can be found in Miller (1995).

Figure 5-1 Quadrant Framework



The framework presents an overview of the delivery methods and financing options, which can be used by the owner/client if there are no laws or regulations prohibiting the use of any one of them.

The horizontal axis represents the delivery method of the project. The range of alternatives for project delivery methods includes one extreme, the complete separation of the project phases, where all phases are provided by separate entities such as in Design-Bid-Build and the other extreme, the combination of all of them, where all phases are delivered by one entity such as in DBO. In between these two extremes are many facets.

The vertical axis represents the owner's/client's involvement concerning financing. One possibility for the owner/client is to assume all financial risk and pay each entity for work performed. Another one fundamentally different option is to transfer all of this risk to a producer who is confident and able to handle it. In between these two extremes are many facets.

Each of the delivery methods in this framework inherits distinct characteristics as well as advantages and disadvantages which will be explained further later on.

5.2 Delivery Options

The horizontal axis of the Quadrant Framework represents the different delivery methods. This axis represents a continuum and the following descriptions are only some possible approaches separated into segmented and combined delivery. There are two extremes of delivery options, which are complete separation and complete combination of the various phases of the delivery process.

The owner/client has to recognize that the horizontal axis describes a continuum and that different approaches to delivering a project exist.

5.2.1 Segmented

A segmented delivery method is one in which the various phases of the delivery process are purchased separately. The basic difference between a segmented and a combined delivery method is the separation of the financing and/or the O&M phase from the design and the construction. Approaches of segmented procurement methods, which are used during this thesis, are General Contractor, Multiple Prime, Construction Management, Design-Build, and Turnkey. Depending on the method chosen multiple contracts are necessary to procure the project. Furthermore, all these methods require the owner/client to arrange separate contracts for financing and O&M.

Lately the introduction of the Design-Build method is taking place. This method combines the design phase with the construction phase and is offered to the owner/client by one entity. The potential of this method to offer savings in cost and time as well as an increase in quality can be noticed (Konchar and Savido 1998).

Turnkey with short-term financing is a method where the owner/client only has to obtain long-term financing, which decreases his costs since the rates for long-term financing are usually more favorable.

5.2.2 Combined

A combined delivery methods is one in which the financing and/or the O&M phase is included in the contract. Approaches of this strategy are DBO and DBFO. The application of these methods is increasing. In the public sector these systems are very likely to be used e.g. for toll roads, airports, wastewater treatment facilities, and energy producing facilities.

DBO and DBFO offer the owner/client the possibility of obtaining all services from one entity and may reduce the costs over the whole life cycle of the project. Furthermore, they can offer the owner/client less involvement in obtaining short-term and long-term financing as well as in the operational phase of the project. These methods can provide independent checks on the technical and financial viability of the project by the producer. Development and introduction of innovations in technology, design, construction, and operation processes can also be provided.

The different approaches to project delivery are explained in depth in section 5.4.2 of this thesis.

5.3 Financing Options

This axis represents a continuum and the following descriptions are only some possible approaches. There are two extremes of financing options, which are direct and indirect financing.

The vertical axis of the Quadrant Framework represents the owner's/client's involvement concerning financing. This axis represents a continuum and the following descriptions are only some possible approaches separated into direct and indirect financing strategies. There are two extremes of financing options, which are complete financing by the owner/client and complete financing by the producer.

The owner/client has to recognize that the vertical axis describes a continuum and that different approaches to financing a project exist.

5.3.1 Direct

As already noted earlier, there are two financing strategies. The first strategy is the direct financing option. This implies that projects are directly financed by the owner/client. In this case the use of available sources – capital through debt, bond issuance, or equity – is necessary.

Direct financing can be provided in different ways:

- directly paying the different parties – architect/engineer, general contractor, operator – of the project either for work performed or, what is possible in the case of a DBO project, by providing regular payments over the projects life cycle,
- offering the producer an equivalent of direct cash payments, such as the right to collect user charges, or
- offering the producer a subsidy or capital incentive and/or transferring the right to collect user charges.

Whenever owner/client capital is used such as cash appropriations of equivalents the direct financing option is applied.

An example is the procurement of a toll road, where the design, construction, financing, and O&M is provided by a single entity. In the case of a direct financing strategy the owner/client offers an incentive in form of a monthly, yearly, or single cash payment and the remainder is provided by the collection of tolls.

In the public sector such a use is linked to pushing projects through directly investing funds in the project.

5.3.2 Indirect

In the case of indirect financing the owner/client does not offer the producer any capital appropriations. The producer has to secure financing for all phases of the project by himself. The advantage for the owner/client of such a strategy is the transfer of all financial risk including revenue risk to the producer. This financing strategy is only possible if the project is financially viable. Therefore, a certain mechanism to generate income needs to be in place – such as in the case of toll roads, tunnels, and airports.

In the public sector such a use is linked to pulling specific projects through incentives, dedicated income streams, mandates, or other means. These means are in place to encourage the producer to embark on a project where no financing is provided by the owner/client.

In the private sector such a financing option is used to procure assets with off-balance sheet financing. For example if a plant is build for a company using an indirect financing strategy, the producer is entitled to collect rent from the owner/client but the asset does not appear on the owner's/client's balance sheet.

5.4 Delivery Methods, Contract Types, and Award Methods

5.4.1 Delivery Method Components

A delivery method consists of four components – the scope, the organization, the contract, and the award. Before an owner/client can procure a project he has to analyze the different components and choose the most appropriate one based on the characteristics of the project and the owner/client.

In the following section different organizations, contract and award methods are explained.

5.4.2 Delivery Methods

The described Quadrant Framework offers an insight into the different organizations available to the owner/client. The following paragraphs will explain some approaches in depth outlining the advantages and disadvantages of them. This is necessary for the owner/client to fully understand the process related to each in order to be able to apply them to a specific project.

5.4.2.1 Segmented, Directly Financed

The following methods fit into quadrant IV of the framework:

5.4.2.1.1 General Contractor

The segmented, directly financed delivery method with a General Contractor as the constructor separates all the phases of a project from each other. The owner/client has to contract with each entity separately – the designer, in charge of the architectural and engineering side, the General Contractor, in complete and sole charge of the construction phase, and the operator, in charge of the operating phase. Furthermore, the owner/client has to secure the financing before he can proceed with the project. This is the case, since the operations phase with a potential to generate revenue, if there is one, is separated from the design and the construction phase.

The method of using a General Contractor has distinct stages. First, a project need is required to be identified. Then the owner/client contracts with a designer.

In the case of a fixed price contract with a General Contractor the design plans and specifications need to be 100% complete before the bidding phase can commence. Usually the General Contractor who submits the lowest bid is then chosen for the construction phase. He has to complete the project based on the furnished design documents by a specified date and within the contract price. Unforeseen site conditions and scope changes

often result in adversarial relationships due to the accounted completeness of the plans and specifications.

In the case of a reimbursable contract the owner/client can put out to bid already completed parts of the design before it is 100% finished. The chosen General Contractor then has to complete the project by the specified time but is paid for the incurred expenses plus overhead and profit. In this connection, the General Contractor can also provide pre-construction services.

In both cases, the owner/client is responsible for the oversight of the construction process and is in charge of giving instructions since the designer and the General Contractor don't have a contractual relationship.

In its basic form – General Contractor with a fixed price contract – this method is appropriate for projects where the scope can be clearly defined before General Contractors bid on it.

Advantages – fixed price contract:

1. Method is well established and understood by the different parties and the court, legal and contractual precedents exist
2. Multiple design professionals are available to the owner/client
3. Independence of design professional offers the owner/client an unbiased entity to monitor the construction work with the owner's/client's interest in mind
4. During the design phase flexibility for changes is given and alternative designs can be explored
5. Complete design should result in accurate construction estimates
6. Total construction site responsibility can be delegated to one entity
7. Total costs known prior to the start of construction
8. Low price can be obtained by competitive bids
9. Construction risk is assumed by contractor except for changes or unforeseen site conditions

Advantages – reimbursable price contract (only those, which are different from above are listed):

1. A fast-track schedule can be used because design does not need to be completed prior to bid
2. Involvement of General Contractor in the design phase is possible
3. Design changes during the construction phase are easier to handle if this part of the design is not already awarded

Disadvantages – fixed price contract:

1. Design usually does not benefit from contractor's or operator's expertise
2. Due to sequential schedule the time to completion is usually the longest
3. Often an adversarial relationship evolves between owner/client and General Contractor as well as between designer and General Contractor in which case the owner/client has to function as a referee
4. Changes and unforeseen site conditions often result in disputes and litigation increasing overall construction costs
5. Owner/client has minimal control over the performance of the construction work
6. Low bid pressure can result in the use of marginal subcontractors
7. Only one design option is evaluated
8. If savings occur during the construction process the owner/client has no share

Disadvantages – reimbursable price contract (only those, which are different from above are listed):

1. If no price limit is set the price might not be known until the end of construction work
2. If no price limit is set there is no incentive for the General Contractor to limit cost

A similar list can be found in Gordon (1991) and Mahoney (1999).

5.4.2.1.2 Construction Management

There are different methods of Construction Management. Two major forms are “Agency Construction Management” and “Construction Management at Risk”.

Usually the Construction Manager is hired based on qualifications and fee. He can then provide pre-construction and construction services. He is responsible for coordinating the team and is in charge of overseeing the project including keeping track of costs and schedule for the parties involved.

This method requires the owner/client to hold separate contracts with the designer and the operator of the project and to secure financing prior to the start of the project.

It offers the possibility of a fast-track schedule since already completed parts of the design can be put out to bid prior to its 100% completion.

In the “agency” form the owner/client contracts with the Construction Manager and holds separate contracts with the subcontractors. The Construction Manager’s single role is to function as an agent throughout the course of the project.

In the “at risk” form, there is the possibility that either the owner/client or the Construction Manager contracts with the subcontractors. In this case, the Construction Manager usually holds a Guaranteed Maximum Price contract, guaranteeing a maximum price for the project.

Often an agency Construction Manager is transformed to a “Construction Manager at risk” when design documents are 60-80% complete. The Construction Manager then guarantees a maximum price for the project including the whole construction costs. (Very similar to this form is a General Contractor holding a reimbursable contract.)

This method is generally appropriate for projects where the scope is still undefined and evolving, what is often the case in the private sector where flexibility during the construction process is needed. In this case a Construction Manager has the possibility to offer his services during the design phase.

Advantages:

1. Construction Manager's expertise can be utilized during all phases for constructibility advice, value engineering, estimating, scheduling, construction performance, bid evaluation, etc.
2. Design interaction between owner/client and designer is possible
3. Coordination between design and construction can be improved
4. Time to completion can be reduced by the use of a fast-track schedule
5. Contractors can be chosen by competitive bid to allow price competition
6. Increased flexibility for changes during construction phase
7. Potential of adversarial relationships between the different parties is reduced
8. Construction risk is assumed by the contractor except for changes and unforeseen site conditions
9. Can be used also for public projects without a change in law

Disadvantages:

1. In the case of a fast-track schedule, the price is not known prior to the commencement of construction
2. Usually no maximum price is guaranteed by the Construction Manager
3. Owner/client has to be aware of his responsibilities and obligations in order to fulfill them
4. Project success greatly depends on the management, scheduling, estimating, and planning skills of the Construction Manager
5. Owner/client has minimal control over the performance of the construction work
6. Low bid pressure can result in the use of marginal subcontractors

A similar list can be found in Gordon (1991) and Mahoney (1999).

5.4.2.1.3 Multiple Primes

This delivery method again separates the different phases from one another.

The owner/client contracts separately with a designer and an operator. Furthermore, financing has to be secured prior to the start of the project. The owner/client holds all contracts with the subcontractors. This can either be by contracting with few large General Contractors each capable of performing different trades or by contracting with each trade contractor separately. Therefore, this method gives the owner/client the opportunity of direct access to the market.

It also offers the owner/client the possibility to fast-track the project by putting out to bid the completed parts of the design. But no pre-construction service is available for the owner.

The owner/client has the responsibility of overseeing and coordinating the whole process since the subcontractors don't have a contractual relationship with each other, are not in charge of the whole project, nor are legally bound to a successful completion. This demands for a high construction, administrative, scheduling, and estimation sophistication of the owner/client or his staff, or a consultant needs to be hired to assist the owner/client in these tasks. The owner/client also has the possibility to assign one of the larger contractors to the management responsibilities.

The owner/client has to be aware that the higher the number of contracts is the more complex the management responsibilities are.

This method is only advisable in cases where the owner/client and his staff have a high level of experience to fully control all aspects of the project.

Advantages:

1. Allows fast-track schedule of the design and construction work
2. Increased flexibility for changes during construction phase
3. Owner/client has direct access to the construction market and can take advantage of the use of competitive forces

Disadvantages:

1. In the case of a fast-track schedule, the price is not known prior to the commencement of construction
2. Owner/client has to be aware of his responsibilities and obligations in order to fulfill them
3. No pre-construction advice towards constructibility, value engineering, estimating, etc. can be provided by an independent contractor
4. High construction sophistication and involvement of the owner/client is needed
5. High need for construction coordination of the multiple contracts – can be difficult and costly for the owner/client
6. Scope changes and unforeseen site conditions can affect multiple contractors
7. Low bid pressure can result in the use of marginal subcontractors

A similar list can be found in Gordon (1991) and Mahoney (1999).

5.4.2.1.4 Design-Build

This less segmented, directly financed delivery method combines the design and the construction phase. Financing still has to be secured by the owner/client in advance.

This approach offers the owner/client a single point of responsibility for the two phases.

The selection process can follow specific stages. One possibility is: The owner/client has to develop a functional design (about 5-10% design completion) if needed with the help of a designer, afterwards a Request for Qualifications is issued, teams show their interest, qualified teams are selected, a Request for Proposal is then issued, proposing teams submit design, schedule, and price based on the specifications, one team is then selected by the owner, which finishes the design with interaction with and approval by the owner/client. After this process construction commences.

There are different ways of a Design-Build team: (1) a consortium, where the contractor has the lead and subcontracts design, (2) a consortium, where the designer has

the lead and subcontracts construction, (3) one firm offering both, and (4) a Construction Manager subcontracting design and construction tasks.

This method allows for a fast-track schedule. It furthermore can increase the interaction between designer and contractor and can reduce the adversarial relationship of the parties involved. Depending on the specifications provided, this approach can also lead to innovation in the design. But it also leaves the owner/client with less control over the design process.

The owner/client has to be aware of the importance of the furnished specifications. If the specifications cannot provide clear and verifiable expectations the owner/client might not get what he wants. High sophistication in this regard is desirable.

Since design and construction is combined an important issue becomes the life cycle costs of the project. Especially in the case of Design-Build with a fixed-price contract the team might try to win the competition with a design of low initial costs but high O&M requirements.

In the case of a reimbursable cost-plus contract the owner/client has to carefully monitor the design and costs of the project since overdesigning can result and no incentive exists to limit costs.

Design-Build with a fixed-fee contract is common for simple projects where the scope can be specified easily. The method with a reimbursable contract is more common for complicated projects e.g. in cases where the scope is still undefined and evolving.

Advantages – fixed price contract:

1. Total price and schedule is known prior to the commencement of design and construction
2. Single point of responsibility for design and construction available to the owner/client
3. Increased teamwork between designer and contractor during the design phase
4. Possibility of incorporation of contractor expertise in the design
5. Owner/client coordination between design and construction is reduced

6. Time to completion can be reduced by a fast-track schedule
7. Owner/client has no liability for change orders, except for scope changes or unforeseen site conditions

Advantages – reimbursable price contract (only those, which are different from above are listed):

1. Changes are easier to handle because of the single point of design and construction responsibility
2. Selection can be solely on qualifications

Disadvantages – fixed price contract:

1. Design changes can be very expensive and difficult for the owner/client
2. Flexibility in and control over the detailed design process is lost
3. The independent relationship of the designer to the contractor and the direct relationship of the designer to the owner/client is lost
4. Owner/client needs to be sophisticated about establishing a clear scope and monitoring the process
5. The project might not be able to fully comply with the owner's/client's expectations due to the minimum involvement during design
6. An independent engineering check is not provided and the owner/client might not be aware of problems during design and construction

Disadvantages – reimbursable price contract (only those, which are different from above are listed):

1. In the case of a fast-track schedule, the price is not known prior to the commencement of construction
2. Less accountability, and possibly less efficiency, exists due to less owner/client involvement

A similar list can be found in Gordon (1991) and Mahoney (1999).

5.4.2.1.5 Turnkey including short-term financing

This delivery method offers the owner/client the same advantages of a single entity responsible for design and construction as Design-Build. It furthermore provides the construction finance of the project. The owner/client pays the team a lump-sum at completion and start-up of the project.

This leaves the owner/client only with the responsibility to secure long-term financing. Furthermore, it requires him to hold a contract with the operator.

The team can be chosen the same way as the Design-Build team. It consists of a designer, contractor, and an investor.

The owner/client has to recognize that again clear and verifiable specifications need to be established prior to the Request for Qualifications in order for the final project to fully comply with the expectations.

The choice of this delivery method with the advantage of short-term financing provided by the team should only be of a decisive nature if it is either cheaper for the team to secure construction financing, if the owner/client has a limit on expenditures for a given year, or if the owner/client is only able to secure long-term financing for the project. In the later case, this delivery method is an opportunity for the owner/client to procure a project if he can secure long-term financing based on revenue projections.

This method is commonly used e.g. on power plants in which case performance specifications are more important than design details.

Advantages:

1. Usually total price and schedule is known prior to the commencement of design and construction
2. Single point of responsibility for design and construction available to the owner/client
3. Increased teamwork between designer and contractor during the design phase
4. Possibility of incorporation of contractor expertise in the design

5. Owner/client coordination between design and construction is reduced
6. Time to completion can be reduced by a fast-track schedule
7. Short-term financing is delegated to the turnkey team
8. Owner/client has no liability for change orders, except for scope changes or unforeseen site conditions

Disadvantages:

1. Design changes can be very expensive and difficult for the owner/client
2. Flexibility in and control over the detailed design process is lost
3. The independent relationship of the designer to the contractor and the direct relationship of the designer to the owner/client is lost
4. Owner/client needs to be sophisticated about establishing a clear scope and monitoring the process
5. The project might not be able to fully comply with the owner's/client's expectations due to the minimum involvement during design
6. An independent engineering check is not provided and the owner/client might not be aware of problems during design and construction

A similar list can be found in Gordon (1991) and Mahoney (1999).

5.4.2.2 Combined, Directly Financed

The following method described fit into quadrant I of the framework:

5.4.2.2.1 Design-Build-Operate

This delivery method combines the phases of design, construction, and O&M. The owner/client contracts with a single entity for all these tasks, which then takes on the responsibility for them. The single entity can be a joint venture of different firms offering

the needed services – a designer, a contractor, a force offering O&M, and, if needed, an investor.

The financing of the three phases still needs to be provided by the owner/client. This can happen in various ways such as:

- directly paying the producer either for work performed or by providing regular payments over the projects life cycle,
- offering the producer an equivalent of direct cash payments, such as the right to collect user charges, or
- offering the producer a subsidy or capital incentive and/or transferring the right to collect user charges.

After a specified amount of time the project is turned over to the owner/client for O&M.

This delivery method also offers the possibility of fast-track construction.

Additionally, it offers the owner/client the same advantages as Design-Build with the added feature of the inclusion of the operational phase.

This procurement method increases the interaction between the designer, constructor, and operator. This can result in a design, where the constructor's expertise towards constructibility and value engineering is incorporated as well as the operator's expertise concerning the life cycle value of the project. All parties have the opportunity to review the design in connection with their needs. Furthermore, this delivery method offers the opportunity of technological innovation since all parties can be involved during the design phase. This increases the overall value of the project and makes it especially attractive.

For this delivery method the owner/client has to be very sophisticated about the whole process in order to get the desired quality of design, construction, and O&M. His responsibility lies in the preparation of clear specifications including the expectations for the operational phase. The functional level of the design is usually about 5-10% completion. The team can be chosen the same way as a Design-Build team.

Depending on the way the project is financed, the owner/client can take advantage of not needing to provide the full cost for design and construction at once, therefore being

able to redirect the limited amount of available funds to more urgent projects, which cannot be financed through revenue generation.

Here the financial risk is with the owner/client. If revenue is generated and the projected revenue is not met, the owner/client has to cover the remaining costs.

This method is attractive for projects, where revenue can be generated, but the project is part of a system. It is also attractive for owners/clients who are not able to finance the project at once.

The feature of including the operations phase in the contract can increase the quality of the project.

Advantages:

1. A single point of responsibility for design, construction, and O&M is available to owner/client
2. Total design, construction, and operation costs and schedule can be known prior to contract award
3. Owner/client coordination between design, construction, and O&M is reduced
4. Time to completion can be reduced by a fast-track schedule
5. Increased teamwork between designer, contractor, and operator during the design phase
6. Possibility of incorporation of contractor and operator expertise in the design
7. Changes are easier to handle because of the single point of design and construction responsibility
8. Owner/client has no liability for change orders, except for scope changes or unforeseen site conditions
9. Strategy can encourage the use of new technology and innovation

Disadvantages:

1. In the case of a fast-track schedule, the price is not known prior to the commencement of construction

2. Design changes can be very expensive and difficult for the owner/client
3. Flexibility in and control over the detailed design process is lost
4. The independent relationship of the designer to the contractor and the direct relationship of the designer to the owner/client is lost
5. Owner/client needs to be sophisticated about establishing a clear scope and monitoring the process
6. The project might not be able to fully comply with the owner's/client's expectations due to the minimum involvement during design
7. An independent engineering check is not provided and the owner/client might not be aware of problems during design and construction

A similar list can be found in Gordon (1991) and Mahoney (1999).

5.4.2.3 Combined, Indirectly Financed

The following method described fit into quadrant II of the framework:

5.4.2.3.1 Design-Build-Finance-Operate

This delivery method combines the different phases of a construction project. Not only is the design, construction, and O&M task with the producer but he also provides the financing for all phases – short-term as well as long-term. The team can be a joint venture of different companies offering the services of design, construction, O&M, and investment.

The owner/client contracts with only one entity, which then is responsible for all different functions of the project.

The project is procured basically the same way as a Design-Build project. But the scope definition needs to include the operational part of the project and in order for the final project to comply with the expectations a clear scope definition needs to be provided.

It is then designed, constructed, operated and maintained, and financed by this single entity.

This method offers basically the same characteristics as the DBO method concerning the inclusion of construction and operation advice during the design phase. It is also a method which fosters technological innovation since the producer needs to operate the project for a certain amount of time and is fully responsible for the financial viability. Therefore, any cost savings the producer can get by innovating can be included. In addition, this system offers a financial viability check by an independent firm, the producer. Private producers will usually only compete for projects which can be financially self-supporting – being able to pay back the debt, offer stakeholders an attractive return, and leaving a reasonable profit margin for the producer.

The financial and performance risk is with the producer in this procurement system.

This method is commonly used for projects, where sufficient revenue can be generated and the project stands alone. Examples are bridges, tunnels, and roads.

It is an attractive method especially for the public sector since no financial commitment is made and the saved resources can be directed towards other projects.

For the private sector this is attractive since this is an off-balance sheet financing method.

Advantages:

1. An independent evaluation of the financial and technical viability of the project is provided by the private sector
2. Financial arrangement and schedule can be known prior to contract award
3. Time to completion can be reduced by a fast-track schedule
4. A single point of responsibility for design, construction, and O&M is available to owner/client
5. Owner/client coordination between design, construction, and O&M is reduced
6. Increased teamwork between designer, contractor, and operator during the design phase

7. Possibility of incorporation of contractor and operator expertise in the design
8. Financial responsibility is delegated to the private producer
9. Strategy encourages the use of new technology and innovation

Disadvantages:

1. Supports only financially viable projects
2. Process may support sole source procurements
3. Design changes can be very difficult for the owner/client
4. Control over the detailed design process is lost
5. The independent relationship of the designer to the contractor and the direct relationship of the designer to the owner/client is lost
6. Owner/client needs to be sophisticated about establishing a clear scope and monitoring the process in order for the project to fully comply with the expectations
7. An independent engineering check is not provided and the owner/client might not be aware of problems during design and construction
8. Owner/client is entirely dependent on one entity

A similar list can be found in Gordon (1991) and Mahoney (1999).

Responsibilities of the involved entities concerning control, payments, safety, bonds, and insurance are described in Gordon (1991).

5.4.3 Contract Types

There are two major types of contracts – fixed price and reimbursable.

The fixed price contract sets a certain amount of money on the work. If the actual costs are below the fixed price, the contractor keeps the savings. If the actual costs are higher than the fixed price, the contractor has to absorb the additional costs. Fixed price contracts are lump-sum contracts and unit-price contracts.

In a reimbursable contract the contractor is reimbursed for all costs – material, labor, and other direct costs – and overhead and profit are included in an additional fee. Reimbursable contracts are cost-plus contracts and fixed fee contracts.

A common hybrid between the two types is a guaranteed maximum price contract, in which case the contractor is reimbursed for his work up to a guaranteed maximum price. Any expenses over this amount have to be born by the contractor.

The choice of the contract type basically revolves around the allocation of the various risks involved in a construction project.

The risks of a construction project usually are related to the complexity of the project, the completeness and/or adequacy of the documents, the likelihood of changes from indecisiveness, external issues, or unknown conditions, and the priority of quality, cost, and time.

Depending on the contract chosen, this allocates the risks differently on the involved entities. The owner/client should strive for a fair allocation of the risk. This will offer the owner/client the possibility to decrease costs since contractors very likely add a premium for risk they are less suited to bear.

A fixed price contract is only recommended for projects, which can be clearly defined. Otherwise, change orders and claims will increase dramatically to cover additional costs for work, which was not included in the scope.

The other extreme, a cost-plus contract, is only recommended for emergencies, the owner/client is confident to control costs, or the price does not matter.

A further description of the different contract types and their advantages and disadvantages can be found in Gordon (1991).

5.4.4 Award Methods

There are different ways to award a contract – the method used to select the contractor and/or the price. These methods include competitive bidding, proposing for a cap,

negotiation, qualification and price bidding, time and price bidding, qualification, time, and price bidding, and design and price bidding.

The award method is very important considering the fact that there is no list price for projects since all projects are different. The award method can lead to the use of market forces and expertise in order to obtain a project with a desired value at a reasonable price.

The two extremes are competitive bidding and single source negotiation.

Competitive bidding is seen as a way to reach the market price and to eliminate the possibility of favoritism and corruption. Because of these reasons, this method is usually used by the public sector. In order to get competitive bids, the specifications on which the bids will be based on need to be clear and verifiable so that the different bids can be compared. This is difficult to attain in the case of an owner/client who is not familiar with the process and therefore cannot clearly specify the scope or in the case where a complex or dynamic project makes it hard to clearly specify the scope.

In this regard, negotiation offers a better relationship. However, this method might not be able to determine the market price if only a single contractor is involved.

The other methods are variations in between the two extremes.

The most important decision, which needs to be made, is if the project is perceived as being a commodity, where materials and labor are a substantial part, or a service, where technical expertise and management abilities are more important.

In the case of a commodity, an award method based on price might be best suitable. In the case of a service, an award method based on qualifications might be more suitable. Again, there are many variations in between.

A further analysis of the different award methods and their advantages and disadvantages can be found in Gordon (1991).

6 Project and Procurement Method Selection

6.1 Background

Over the last decade the use of alternative delivery methods has increased. This results in a need for a selection process, which can offer the owner/client assistance in choosing an appropriate delivery method.

Various selection models have been developed to help the client choose the most appropriate procurement method for specific needs (Gordon 1991, 1994; Alhazmi and McCaffer 2000). The various models, however, do not take into consideration important factors inherent in a project and of importance to the owner/client. These factors are portfolio issues, financing issues, and the inclusion of the O&M phase.

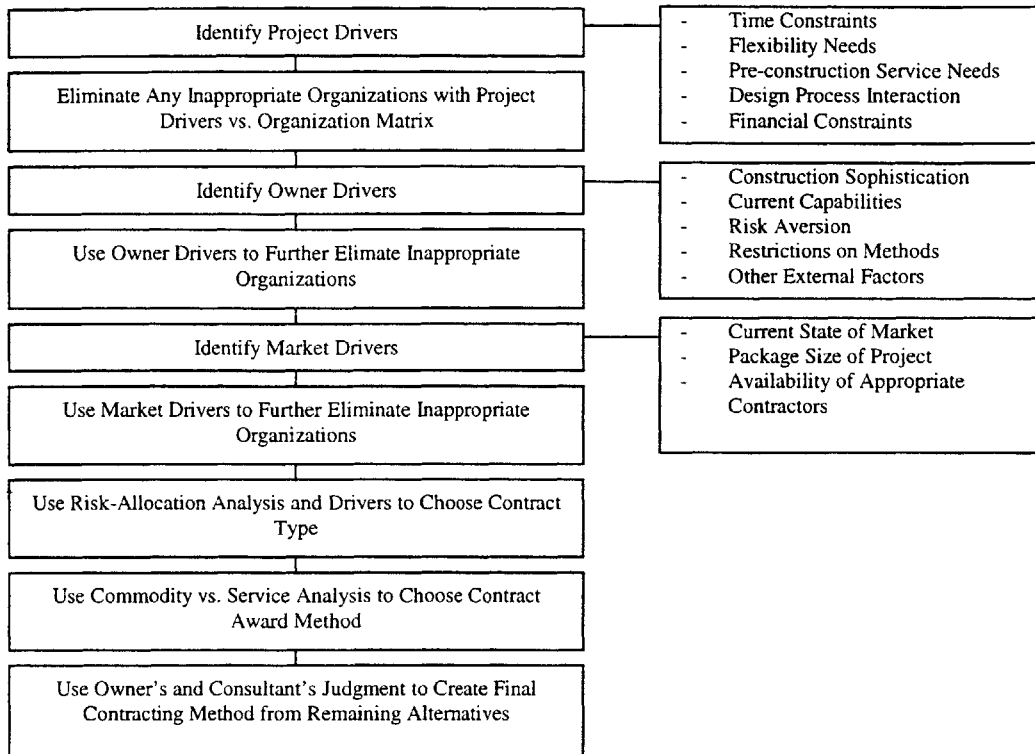
Gordon (1991, 1994) developed a selection model, which uses three different drivers – project, owner, and market – and which are of significance to the project and the owner/client. After the “driver” evaluation, inappropriate organizations are eliminated, a risk-allocation analysis is conducted to choose an appropriate contracting method, and a commodity vs. service analysis leads to the best suited award method.

This methodology includes the organizations of General Contractor, Construction Management, Multiple Primes, Design-Build, Turnkey, and Build-Operate-Transfer (BOT). BOT in this context is a delivery method, which combines design, construction, and O&M and is either financed by the owner/client, the producer, or by both.

Since this methodology was developed almost a decade ago in 1991, the use of the different delivery methods has increased and definitions have developed further. Gordon lists six different delivery methods, which are offered as possible options. These are General Contractor, Construction Manager, Multiple Primes, Design-Build, Turnkey, and BOT.

Gordon's methodology uses a linear process, which is shown in **Figure 6-1**:

Figure 6-1 Method Selection Flowchart by Gordon (1991, 1994)



As already noted above, this methodology does not include considerations concerning the portfolio, the budget, and the characteristics of the O&M phase. It furthermore, does not separate BOT into direct and indirect financing strategies (DBO and DBFO), which are important during portfolio considerations.

Since the number of projects and assets, which need to be procured, repaired, maintained, improved, and renewed, increases and the resources for the projects decrease, these factors become more important in the future. The O&M phase becomes especially important for projects, where the owner/client is not the entity best suited for this phase and a private producer can better employ market forces.

One more important issue, which is not taken into account, is the openness of the system. Different models use a linear process in choosing an appropriate delivery method. But as it becomes more important to consider the portfolio during the project and

procurement method selection process, it is necessary to be able to revise decisions in order to reach the greatest benefit for the portfolio at the known resource constraint. This includes the necessity to evaluate a number of projects at the same time so that a mix of projects can be chosen, which offers the owner/client the possibility to reach his goal.

The not accounted for important factors – portfolio, budget, O&M, openness of system, and separation of BOT into DBO and DBFO – make it necessary to extend the selection process developed by Gordon in order to accommodate them.

In the following section, the methodology is therefore modified and extended in order to take into account the importance of these factors as well. For the owner/client this will be a process, during which he has to assess the different drivers of the project – project, owner, business, construction market, and portfolio – which present the characteristics of it.

The offered methodology is divided into three sections – the procurement method selection, the project selection, and the contract and award method selection. As delivery methods this methodology lists General Contractor, Construction Management, Multiple Primes, Design-Build, Turnkey incl. short-term financing, DBO, and DBFO.

The first part focuses on the elimination of inappropriate delivery methods. It will follow subsequent steps: (1) Every project of the portfolio is assessed concerning the project drivers. This will eliminate inappropriate delivery methods using the Organization Selection Matrix. (2) Every project of the portfolio is analyzed in regard to the owner drivers. This will further eliminate inappropriate organizations. (3) Every project needs to be assessed concerning the business drivers. This will offer assistance in choosing a viable financing option. Inappropriate organizations are eliminated. (4) Every project is analyzed in regard to the construction market drivers, what will eliminate any inappropriate organizations. After the driver analysis a list of projects with their feasible delivery methods as alternatives remains. (5) In order to choose viable organizations from the remaining alternatives, a financial analysis for every project needs to be conducted. In this connection it is necessary that the time period of this cash flow analysis stays the same for

every project. This will eliminate organizations by rejecting delivery methods, which are not viable alternatives. After this process the owner/client is able to consider different approaches to the procurement of the project. This process' intention is not to produce a single possibility, it rather tries to offer the owner/client to base his decision of the procurement methods on the portfolio, budget, and schedule. The owner/client has to recognize that no single delivery method is best suited for a project. Different approaches can offer satisfactory results.

The second part will consider the different projects and their feasible delivery methods and provide assistance in the project selection process. It will follow subsequent steps: (1) In order to be able to decide, which projects are to be procured, scenarios need to be configured. The variables during this process are schedule and delivery method. The schedule concerns the timing of a project and its duration. The delivery method concerns the inclusion of different feasible delivery methods of a project in these scenarios. Resulting from these two variables is a different outcome in the availability of resources, since the variables effect the contribution to and use of obtainable capital through different combinations of projects. (2) The owner/client has to analyze and compare the configured scenarios based on the combination of projects, the available capital, and the schedule. This decision has to be based on following portfolio drivers: (a) new resources, (b) current costs, and (c) desired performance. This will result in the choice of one scenario employing the owner's/client's judgment, which can offer the greatest benefit for the portfolio at the resource constraint.

The third part focuses on the selection of a contract and award method based on the risk allocation and commodity vs. service analysis for each project, which will be procured in the current period.

In the following planning period the owner/client has to review his choice and its implementation. For this period's strategy he must reconsider the projects, which have not yet been procured and either approve last period's decision or revise it. This concludes in a new start of the whole process including these projects in addition to new projects.

Before the owner/client can begin to choose the procurement method and the best mix of projects to reach the greatest benefit, he has to gain an understanding of the important characteristics of the project, such as the scope, the cost, the schedule, the condition, the cash flow, and the current cost of existing projects.

The methodology is established from the owner's/client's point of view.

6.2 Organization Selection

The procurement method selection starts with the evaluation of the drivers, which are important to the project. This will eliminate inappropriate methods. The owner/client has to realize that there is no right or wrong answer, instead different methods are feasible for a single project. In order to evaluate the available methods different characteristics to the project have to be assessed: (1) project, (2) owner, (3) business, and (4) construction market drivers.

6.2.1 Project Drivers

This section will assess the important issues concerning the project. One project driver concerning life cycle value considerations is added to Gordon's original version.

The project drivers are broken down into:

6.2.1.1 Time Constraints

Is time to completion an important factor?

It has to be evaluated what kind of schedule – sequential or fast-track – can be implemented.

In this connection, the decision involves a financial analysis of the additional costs of fast-tracking vs. the value of early completion and a consideration of the regulatory and technical feasibility of each schedule.

6.2.1.2 Pre-construction Service Needs

Are pre-construction services for the project of value to the owner/client?

The owner/client has to evaluate the importance of constructibility advice, value engineering, and cost estimates to him. Pre-construction services can be more or less valuable, depending on the complexity and uniqueness of the project as well as on the owner/client.

6.2.1.3 Design Process Interaction

How much interaction does the owner/client want?

In order to answer this question, the owner/client has to evaluate the importance of design interaction to him. This is usually necessary in cases where a creative design is intended, the appearance is critical, and a certain function needs to be served.

Using an independent designer as in General Contractor, Construction Management, and Multiple Primes, the owner/client has the possibility of high design interaction and control. Fixed price Design-Build and Turnkey, DBO, or DBFO may reduce this interaction. This can be unsatisfactory to the owner/client e.g. in the case of a highly creative design.

6.2.1.4 Flexibility Needs

How much flexibility does the owner/client need during the construction process?

The owner/client has to decide how much flexibility concerning design changes he wants to have. These changes can have two sources: strategy and definability.

In cases where the owner/client is not the end-user, there needs to be a strategy, which allows the end-user the opportunity to modify the design to its needs.

In the case of a complex and large project, sometimes the design cannot be readily defined before construction starts. Other cases where flexibility is needed are if the owner/client is indecisive, required permits are not available on time, or the market is not predictable.

6.2.1.5 Life Cycle Value Consideration

How important is it for the owner/client to include life cycle value considerations into the design?

The owner/client has to evaluate how important life cycle value considerations are. Including these into the design process might reduce the costs for this phase in the future.

If O&M is separated from the design and the construction these issues are usually not included in the design due to the possibility of higher initial costs and the need for higher quality during construction.

6.2.1.6 Financial Constraints

Who can most efficiently finance the project?

The owner/client has to decide who is best suited to efficiently finance the project. Owner/client financing – especially in the public sector – can be cheaper, therefore more attractive to the owner/client. It has to be evaluated, if the owner/client needs construction or permanent financing or if he is able to provide financing completely.

After answering all these questions, **Table 6-1** helps to eliminate inappropriate methods by identifying the rows which reflect the owner's/client's answers. This table is from the owner's/client's point of view. The organizations are partly broken down into the different contract options – fixed price or reimbursable. This was necessary since only looking at the organization seems of low value to the owner/client.

As Gordon (1991) already identified, if all organizations are eliminated, a conflict in drivers exists. These need then to be reevaluated.

Table 6-1 is modified from its original version towards accommodating the use of the Quadrant Framework, the scope of the project, the inclusion of Design and/or O&M as organizations in a Design-Bid-Build and Design-Build procurement, the separation of BOT into DBO and DBFO, and the inclusion of life cycle value considerations during the evaluation of the project drivers.

Table 6-1 Organization Selection Matrix

	Quadrant IV										Q I	Q II
	DBB						DB				DBO	DBFO
	D	GC-FP	GC-R	CM	MP	O&M	DB-FP	DB-R	TKY-FP	TKY-R	DBO	DBFO
Fast-track Schedule	x		x	x	x	x	x	x	x	x	x	x
Sequential Schedule	x	x	x	x	x	x	x	x	x	x	x	x
High Value Pre-constr. Services			x	x			x	x	x	x	x	x
Low Value Pre-constr. Services	x	x	x	x	x	x	x	x	x	x	x	x
Design Interaction	x	x	x	x	x	x		x		x		
Less Design Interaction	x	x	x	x	x	x	x	x	x	x	x	x
More Flexibility	x		x	x	x	x		x		x		
Less Flexibility	x	x	x	x	x	x	x	x	x	x	x	x
High Life Cycle Value			x	x				x		x	x	x
Low Life Cycle Value	x	x	x	x	x	x	x	x	x	x	x	x
Need Constr. Finance									x	x	x	x
Need Perm. Finance											x	x
Owner Finance	x	x	x	x	x	x	x	x	x	x	x	

Annotation: DBB – Design-Bid-Build

D – Designer

GC – General Contractor

CM – Construction Management

MP – Multiple Primes

O&M – Pure Operations and Maintenance

DB – Design-Build

TKY – Turnkey

DBO – Design-Build-Operate

DBFO – Design-Build-Finance-Operate

FP – Fixed Price Contract

R – Reimbursable Contract

An organization is appropriate in cases in which it is able to satisfy the corresponding driver. This can result in the appropriateness of a delivery method in regard to both answers of a driver.

This matrix shows that reimbursable contracts offer the owner/client more features and control than fixed price contracts. The complexity of a project can be better handled the more the different phases are combined. It is important to recognize that this will reduce the owner's/client's control and increase his responsibilities.

6.2.2 Owner Drivers

The owner drivers are important considering the capabilities of the owner/client. The owner/client has to be aware that his sophistication and his capabilities are important issues during the process. This will further improve the quality of the project as well as the whole process. Two owner drivers are added to Gordon's original drivers in order to accommodate process sophistication and operational sophistication. In addition, the charts include the separation of BOT in DBO and DBFO.

6.2.2.1 Process Sophistication

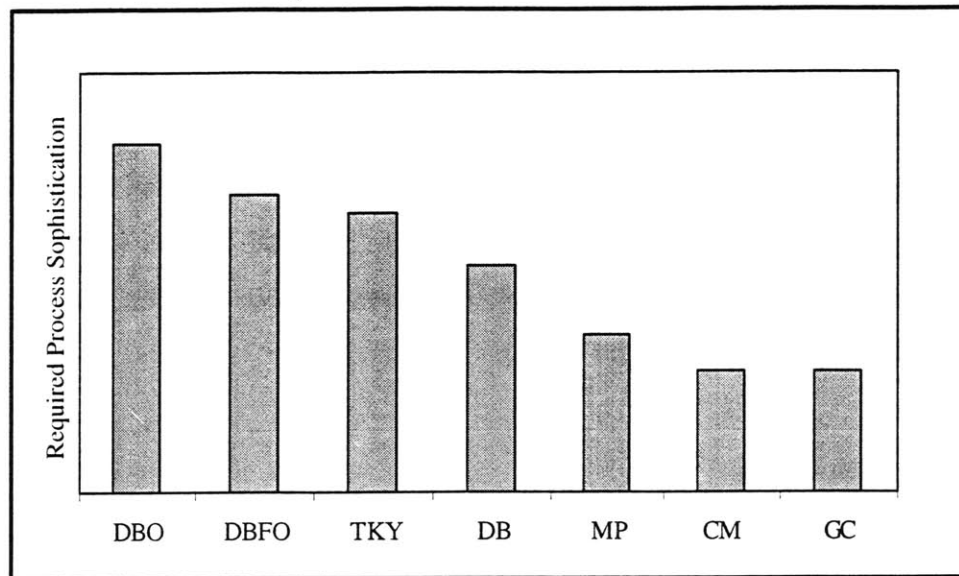
Does the owner/client understand the whole process?

The owner/client has to decide how much he knows about the process of the different delivery methods. This includes being able to recognize the inherent responsibilities of the owner/client. It is very important that the owner/client is aware that the more combined the methods are the more complex his initial responsibilities get.

In order to procure a project, which complies with the owner's/client's ideas, he needs to be able to offer a well-defined scope.

Chart 6-1 represents the relative process sophistication required for each method by the owner/client:

Chart 6-1 Process Sophistication



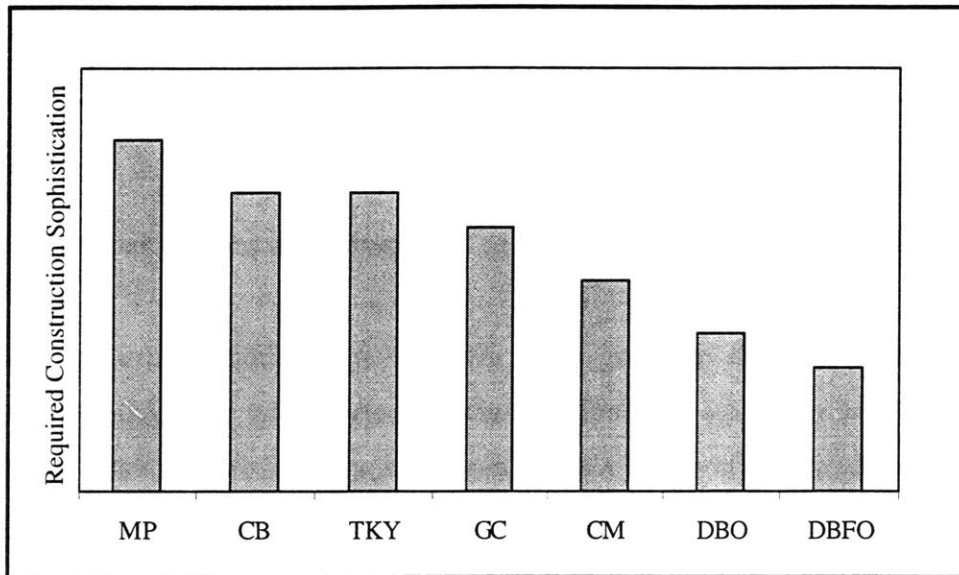
6.2.2.2 Construction Sophistication

How well does the owner/client understand the construction process?

An unsophisticated owner/client will need someone on his side in a fiduciary relationship to advise him during the process. This can either be an independent designer or a construction manager.

Chart 6-2 represents the relative sophistication required for each method by the owner/client:

Chart 6-2 Required Sophistication



6.2.2.3 Operational Sophistication

Who is best suited to operate the facility?

The owner/client has to decide if the owner/client or the producer can more efficiently operate the project. Public owners have already recognized that private producers can more efficiently operate a project than a public bureaucracy. This can result in quality operation and sometimes lower costs to the end user.

Often the owner/client keeps an asset and operates it by himself because he is used to it. But often the owner/client fails to see that this might not be the most efficient way to manage the asset. The owner/client sometimes cannot lower the costs as much as a private producer can who is tied to competitive forces.

This problem can also be applied to a new project, where the owner/client decides to do the O&M for the project because he always does it.

Table 6-2 represents the delivery methods for which high or low operational sophistication is required. It is shown from the owner's/client's point of view

Table 6-2 Operational Sophistication

	GC	CM	MP	DB	TKY	O&M	DBO	DBFO
High Operational Sophistication	x	x	x	x	x			
Low Operational Sophistication						x	x	x

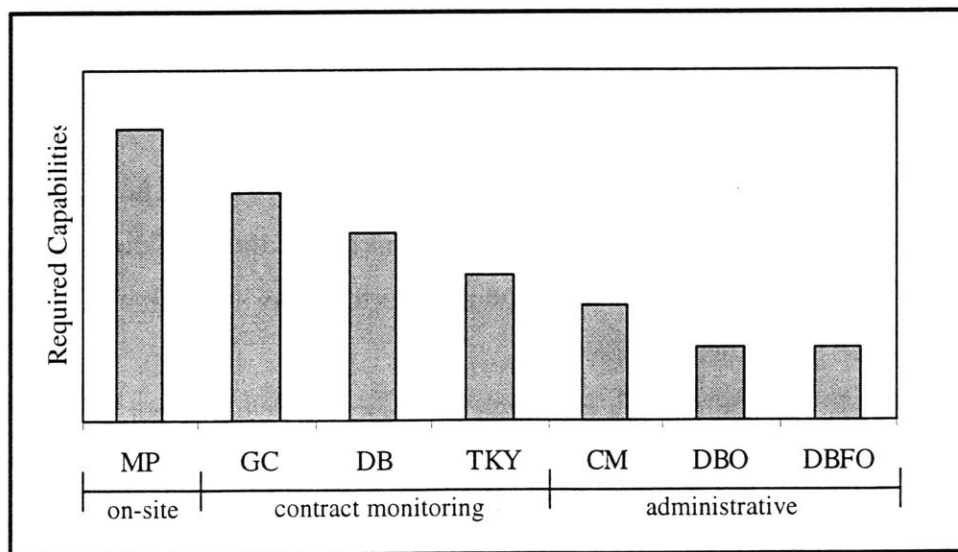
6.2.2.4 Current Capabilities

How much staff can the owner/client commit to the construction process and at which levels?

There are three levels each requiring more involvement – administrative, contract monitoring, on-site – at which the owner/client can be involved. The owner/client has to decide at which level he can be involved with his current capabilities or if he wants to hire additional staff in order to monitor the project at levels with higher involvement.

Chart 6-3 represents the relative involvement required for each method by the owner/client:

Chart 6-3 Required Involvement



6.2.2.5 Risk Aversion

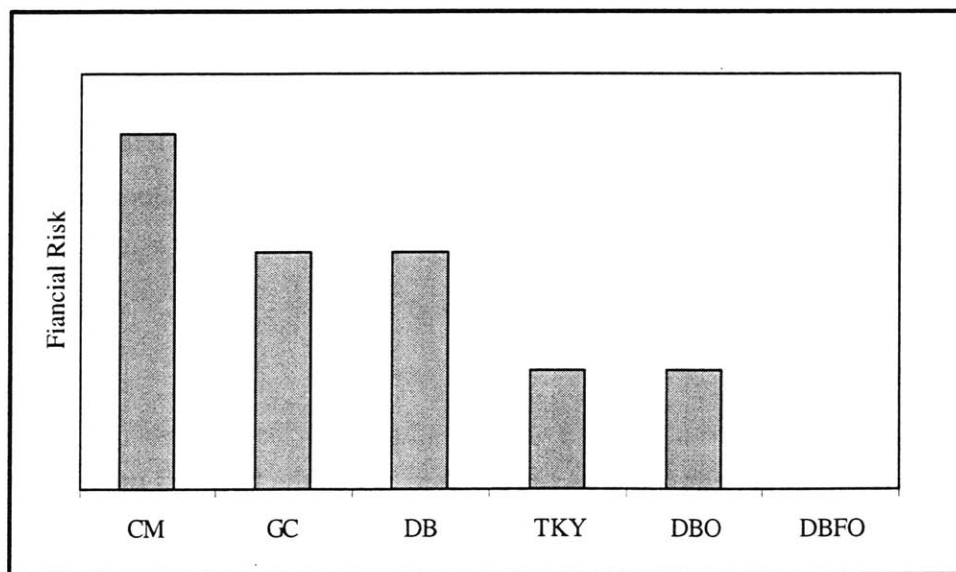
How much risk does the owner/client want to bear?

This question is aimed at the allocation of the risk once the project is procured. The owner/client has to evaluate the different types of risk – complexity of project, completeness and/or adequacy of documents, likelihood of changes from indecisiveness, external issues, or unknown conditions, and priority of quality, cost, and time – and has to decide on a way they are best allocated on the involved parties.

Most of the time financial risk during the construction phase is predominant.

Chart 6-4 represents the relative financial risk the owner/client needs to bear in the case of each organization type and the use of a fixed price contract except for a Construction Manager, where the “agency” form is assumed:

Chart 6-4 Financial Risk



6.2.2.6 Restriction on Methods

Are there regulatory or ethical issues, which restrict the use of a specific method?

The owner/client has to decide if there are issues, which are important to him and can reduce the choice of available delivery methods. This could be laws requiring owners/clients to use or prohibiting them to use a specific method.

Ethical issues could be topics such as doing O&M themselves because of certain preferences.

6.2.2.7 Other External Factors

Are there external factors which influence the owner's/client's choice of a method?

This can be the owner's/client's wish to choose a particular contractor for strategic or political reasons.

It is very important during the assessment of the owner drivers, that the drivers concerning restrictions on methods and other external factors are considered first. This could already eliminate organizations, which are appropriate after the evaluation of the remaining owner drivers.

The assessment of the drivers should now deliver a procurement method, which is suitable for the owner/client and the project.

Concerning the contract method, a thorough evaluation of the inherent risks needs to be conducted. This will lead to an assessment of the party, which is best suited to efficiently carry a certain type of risk. Based on the allocation of the different risks, a certain contract method is best qualified to be used for the project. See Gordon (1991, 1994) for a comprehensive discussion of this matter.

6.2.3 Business Drivers

The business drivers should allow the owner/client to assess the business environment of the project. This type of driver is important considering the financing of the project. This driver is based on an evaluation if an "indirect" financing strategy is viable for the project.

This type of driver was not included in Gordon's methodology. But it was found to be necessary to include it in the context of the need to employ alternative financing strategies.

During this part the functional scope and the related cash flows are of importance in order to be able to answer the questions.

6.2.3.1 Revenue Generation

Is there a possibility to generate revenue through user fees?

This question is aimed to look at the possibility to generate revenue by introducing or keeping user fees. In order to generate revenue a means of how to charge users based on their use of the project needs to exist. In the public sector this is usually the case for highways, airport facilities, port facilities, water treatment facilities, wastewater treatment facilities, land fills, etc. The revenue is generated either through tolls, rent, or fees. In the private sector this can be the case e.g. for plants, which are leased back to the owner/client or hotels where revenue is generated through the customer.

6.2.3.2 Demand

Is there demand from user side for the project?

In order to be able to find out if enough revenue can be generated to support the project financially, there has to be a significant demand from user side. In the public sector this demand can be a need for clean water or a less congested highway. In the private sector this demand is secured e.g. in the case where the owner/client will be the user. In the case where different end-users exist the demand has to be estimated.

If there is low demand for the project revenue generation will be very difficult and the financial risk is high.

6.2.3.3 Growth Opportunity

If revenue can be generated and demand exists is there a growth opportunity concerning user fees?

This question is aimed at projects where user fees are collected.

It is very important to know if the demand will grow so that revenue increases. This will influence the future ability to operate and maintain the project, service debt, and earn a reasonable rate of return. Expenses will increase due to inflation and price increases. An increase in revenue is therefore necessary to be able to pay these expenses – revenue earned today is more worth than compared to the same amount of revenue earned in the future.

Furthermore, it is important to look at the economic cycle during which a project will be built. This is aimed at the question if the economy is in a growth phase so that users will be willing to pay a premium for the strongly demanded project.

In the private sector this question might not be as important for projects, which are proposed in order to meet the owner's/client's demand.

6.2.3.4 Monopoly

Does/Will the project hold a monopoly?

This is a question, which especially affects the public sector in deciding the way of financing. It is usually of importance that the proposed project holds a monopoly in order to secure revenue. A monopoly is usually created by geography or regulatory conditions. In the case of a bridge, the bridge usually holds a monopoly and therefore has a reliable revenue generation. In the case of water treatment facilities there is no substitute for clean water so that again revenue generation is safe. It has to be looked at the existing substitutes in order to be able to recognize if the project will have a steady revenue stream.

6.2.3.5 Owner/Client Support

Can the owner/client support the project?

It is very important especially for the private sector, which will build the project, that the owner/client can commit to the project and can signal that it will be build.

An example where the owner/client couldn't or wouldn't commit to the project is the Dulles Greenway in Virginia, where the state didn't support the project and actually fostered the widening of a competing highway.

It can be seen in Hong Kong during the time of heavy procurement of infrastructure projects that a support from the appropriate local, state, and national government was a prerequisite to make the project suitable for private financing.

6.2.3.6 User Support

Do the users support the project?

This is an important question in the public sector. It should be known in advance if the community is willing to support the project in every instance – e.g. from the introduction of tolls to the environmental impact.

It can be shown from several projects like projects in Minnesota or Washington State that the lack of user support stopped the proposals. In both programs the affected community stopped proposed projects by vetoes.

6.2.3.7 Part of a System

Is the proposed project part of a system?

This question is aimed at the possibility to indirectly finance a project. In the case where a project is part of a system, e.g. part of a water distribution system, a direct knowledge of which facility the water is coming from is not feasible to attain. Therefore, it is not possible to charge users separately since the source is not known. Another example is a bridge, which belongs to a system of bridges. To separate the toll collection is particularly inconvenient for the user e.g. in the case of automated toll collection systems. This limits the choice of financing options to procurement methods, which do not include indirect financing.

6.2.3.8 Assumption of Financial Risk

Who is best suited to assume the financial risk for the project?

It has to be evaluated if the producer or the owner/client is best suited for assuming the financial risk during the different phases of the project. In the case in which revenue can be generated, the demand and the growth opportunity seem positive and can support the project financially, the owner/client is committed to the project, and the producer is financially strong, the assumption of the financial risk by the producer in a DBFO contract is possible.

This means that if the revenue is not sufficient to meet the expenses the producer is financially responsible to cover any outstanding payments.

Once these questions are answered, the owner/client can use **Table 6-3** to evaluate the business drivers of the project. He has to identify the rows with his answers to the questions. This will result in an advice for the financing structure of the proposed project.

Table 6-3 Business Drivers vs. Financing Strategy Matrix

	Direct	Direct With Combination Of User Fees And Owner/ Client Capital	Direct Through User Fees	Indirect
High Revenue Generation	(x)	(x)	x	x
Low Revenue Generation	x	x		
High Demand	(x)	(x)	x	x
Low Demand	x	x		
High Growth Opportunity	(x)	(x)	x	x
Low Growth Opportunity	x	x		
Part Of A System	x	x	x	
No Part Of A System	(x)	(x)	x	x
Monopoly	(x)	(x)	x	x
No Monopoly	x	x		
High Owner Support	(x)	(x)	x	x
Low Owner Support	x	x		
High User Support	(x)	(x)	x	x
Low User Support	x	x		
Assumption Of Financial Risk	x	x	x	
No Assumption Of Financial Risk				x

Annotation: (x) means that this option is still available but might not be the best choice.

“Direct” means that the owner/client can either pay the contractors separately for work performed or, what is possible in the case of a DBO project, by providing regular payments over the project’s life cycle. The contractor has no right to collect any user charges. This financing strategy can be used for General Contractor, Construction Management, Multiple Primes, Design-Build, Turnkey, and DBO.

“Direct with combination of user fees and owner/client capital” means that the owner/client offers a capital incentive and transfers the right to collect user charges to the contractor. This is only a viable option for DBO projects.

“Direct through user fees” means that the owner/client transfers the right to collect user charges to the contractor in the case of a DBO project.

In either case, the financial risk is allocated at the owner/client.

“Indirect” means that the producer completely finances the project without any appropriations from the owner/client by holding a DBFO contract. The financial risk is allocated to the producer.

After using this table and in the case that direct financing through user fees as well as indirect financing seem to be possible options, the owner/client has to be able to establish a cash flow analysis based on the established scope, which will provide him with the Net Present Value (NPV) of the project.

If the $NPV < 0$, it has to be assessed, if a change in scope, revenue, and/or terms of the project can make it viable to be indirectly financed.

If the $NPV \gg 0$, it has to be assessed, if additional scope could be added to the project.

The business driver evaluation might result in a conflict between the appropriate delivery method and the viable financing option such as the elimination of DBO and DBFO as delivery methods in cases where an indirect financing strategy or a direct financing strategy useable only with DBO is viable. This demands for a reevaluation of the project and owner drivers in order to decide if the choice of the financing strategy is inferior or if the scope of the project can be changed towards making these delivery methods viable options.

In most cases where “indirect” financing is a viable option, the “direct” financing strategies are also available. This is important later in the process where the portfolio is considered and scenarios are established. Using indirect financing reduces the use of funds

but also the future contributions to the resources. Direct financing on the other hand increases the use of funds and depending on the project the contribution to the resources. Each possibility should be considered and by choosing a scenario in the end a financing option is chosen, which offers the greatest benefit.

6.2.4 Construction Market Drivers

This type of driver should allow the owner/client to assess the construction market environment in which the project is procured. Answering the questions should offer a very broad concept of the market. It should furthermore deliver an idea on how to package the project and the best time to bid.

6.2.4.1 Construction Market Situation

How competitive is the market?

The current situation of the market affects the choice of how and when to award the project if a competitive bidding system is used.

6.2.4.2 Package Size of the Project

How can the project be packaged so that it maximizes efficiency and gains the most from market competition?

In order to attract competition, the owner/client has to assess if the package size is adequate. This means that if the project's size is too large or too small competition might not offer the best results. A decision has to be made, if the project can either be broken down into smaller, more adequate packages or if some projects can be combined to attract the best competition. Otherwise an inflation of the price in an inappropriate market can result.

6.2.4.3 Availability of Appropriate Contractors/Producers

Is there a realistic chance to attract appropriate contractors/producers?

It has to be assessed if the location offers a variety of appropriate contractors/producers, which can work on the project.

After an evaluation of the project, owner, business, and construction market drivers, appropriate project delivery and financing strategies should have emerged. These delivery methods are based on the owner's/client's capabilities and the project's characteristics. An important matter in this connection is the owner's/client's understanding of the different delivery methods in order to be able to apply them.

6.2.5 Financial Analysis

The next step in choosing feasible delivery methods for each project is to prepare a financial analysis of every delivery method approach for every project. This becomes necessary in the context of the limited amount of available capital, the need for maintaining and improving the current level of service related to a portfolio of current and future projects, and the insufficiency of current resources to fund all projects by the owner/client.

The cash flow analysis should be conducted for each of the delivery methods over a common planning period. This might include the combination of different delivery methods to cover this period and the use of Design and pure O&M in order to prepare complete life cycle cash flows for project delivery methods, which do not include these phases in the contract. During the preparation of cash flows the possibility of combining projects to reduce cost and improve the schedule of construction such as combining projects at the same location should be assessed and included in the financial analysis.

The use of a cash flow analysis over a common period is necessary to be able to compare different approaches financially with the inclusion of O&M costs.

This cash flow analysis can result in an elimination of alternatives for a project. This can arise e.g. from the demonstration that (1) a delivery method might not be able to produce a revenue stream, which is adequate to maintain the project and service debt obligations, (2) the project's complexity and size results in a price, which is too high, and

(3) an appropriate technology is unavailable to reach the desired level of performance (Miller 2000). Before any alternatives are eliminated the owner/client has to examine the delivery methods, which are to be discarded in order to check if the project's scope can be changed reasonably towards keeping these alternatives as viable options. An example is the elimination of DBFO because of an insufficient revenue stream and a negative NPV. The owner/client has to evaluate if this method should be eliminated or if the scope, revenue, and terms of the project can be changed to keep DBFO as a viable option.

This analysis also offers the owner/client to review the scope, the schedule, and the financial commitment and make changes if appropriate. An example is the conclusion that a DBFO project offers such a high return that additional scope can be added for instance by combining it with a project at the same location.

6.3 Project Selection

During this part the owner/client needs to configure a portfolio scenario, analyze it based on portfolio drivers, and choose one, which offers the greatest benefit for the portfolio.

6.3.1 Scenario Configuration

After following the process of choosing appropriate delivery methods based on the driver and financial analysis the owner/client now possesses a list of projects, their viable delivery methods concerning the drivers and financial analysis, and their cash flows.

At this time the owner/client has to build portfolio scenarios of combinations of projects from which he will have to choose one, which offers the greatest benefit to the portfolio. These scenarios employ two variables: (1) delivery methods and (2) schedule. The delivery methods concern the inclusion of all feasible project delivery methods of a project. The schedule variable concerns the alterable timing of the project and its duration.

These two variables result in different outcomes concerning the use of and contribution to the available resources by a different combination of projects.

The scenarios should be configured over a reasonable time frame such as five or ten years. There is an infinite number of scenarios possible by (1) changing the variables and (2) employing different time frames caused by an alteration of the pace of execution of the projects to reduce the needed capital. It has to be recognized that an optimization is impractical in the context of changing project cash flows caused by uncertainties in interest rates, discount rates, revenue stream, and future costs.

During the configuration process the owner/client has to consider the availability of capital and the cost of current assets.

First, the owner/client has to identify the sources of funds and its use, and additional sources and uses by the projects, which will be procured. The sources of funds are (1) in the public sector: (a) revenue from current assets and other revenue, (b) outside funding such as grants, (c) taxes, and (d) bond issuance and obtaining debt, (2) in the private sector: (a) revenue from current assets, and (b) equity and debt. The expenses are generally the costs of maintaining and improving the current portfolio. In addition following sources and uses have to be taken into account for preparing a portfolio scenario: (a) revenue from new projects, (b) costs for procuring the projects, maintaining, operating, and improving them, and (c) savings in expenses through increased efficiency and abandonment of low efficiency projects. These will be the sources and uses of resources in a scenario. During this identification the need for an activity based costing system and a condition assessment method is unavoidable to be able to fully understand the sources of revenue and expenses.

Then the owner/client has to concentrate on the revenue and expenses. He has to take into evaluation that the use of resources cannot dramatically exceed the sources of capital in subsequent years and that a possibility to fulfill the obligations needs to exist.

These considerations are a constraint to the preparation of scenarios. The number of projects in a scenario will be limited inasmuch as only a certain amount of capital is available.

Since not enough capital is available in a single budget cycle some projects need to be deferred, altered in scope, eliminated, or funded through other means than available revenue sources.

The result is a number of viable portfolio scenarios, which present a combination of projects, their delivery methods, their timing and duration, and the required amount of capital.

6.3.2 Scenario Analysis and Choice

The scope of this section is to draw the owner's/client's attention towards choosing a scenario that can increase the performance of the portfolio and produce an agreement between the entities involved, affected, and related to it.

In this context it becomes necessary to evaluate the portfolio drivers: (1) new resources, (2) current costs, and (3) desired performance.

6.3.2.1 New Resources

It is important to evaluate the different configurations based on their possibility to contribute new resources to the available budget. Issues, which can influence the contribution of capital are (1) an increase in efficiency of operations, (2) projects, which offer new sources of revenue, and (3) an increase in quality of assets.

An increase in efficiency can contribute new capital by being able to produce more in the same amount of time and being able to sell it.

Projects with new sources of revenue contribute this revenue to the available budget.

An increase in quality of assets can justify an increase of charges.

6.3.2.2 Current Costs

This issue concerns the possibility to decrease the amount of current expenses. Expenses can be decreased relatively by (1) increasing the efficiency and quality of

operations, (2) improving the condition of assets, (3) evaluating the advantages of repair vs. new construction.

Increasing the efficiency and quality of operations can reduce the costs of operation relative to the increase in output.

Improving the condition of assets can reduce the need for heavy maintenance and major repairs, therefore saving money in the long-term.

By evaluating the advantages of repair vs. the advantages of new construction the owner/client has to consider the efficiency and condition of the asset and has to decide what strategy can decrease costs in the long-term. Although a repair might have lower initial costs, the expenses for maintaining and operating it might reduce the advantages of lower costs in the long-term in contrast to new construction, which can include the introduction of new technology and higher efficiency, therefore reducing the O&M costs dramatically.

6.3.2.3 Desired Performance

This issue concerns the quality of service related to the current portfolio. The owner/client has to evaluate the possibility of improving the performance of the services of the current assets as well as the ability of new projects to enhance the quality of the portfolio for the future. In order to increase the level of performance the owner/client has to decide, which level is desired. This includes the evaluation of costs, quality, and timing of projects. A betterment can be gained by (1) improving the current efficiency of operations of current assets, (2) improving the condition of the assets, (3) deciding on the strategic importance of assets, (4) complying with future regulation/standard changes, and (5) evaluating the advantages of repair vs. new construction.

Improving the efficiency of operations of current assets can increase the performance level of the facility and is also important in regard to new resources and current costs.

Improving the condition of assets is significant in this context as well.

The decision on the strategic necessity of assets concerns the evaluation if a new project can dramatically increase the performance due to changes in technology, which

require implementation to be able to meet the changes of demand caused by society and technological progress.

Complying with future regulation/standard changes is of importance in regard to the ability of current assets to meet these developments and therefore being able to meet the required level of performance/service.

Evaluating the advantages of repair vs. new construction is of significance concerning the ability of a repair to improve the performance to the desired level or if in order to reach this goal a new construction is essential.

After the evaluation of these drivers, the owner/client should be able to judge the different scenarios and to decide on a possible configuration, which can improve the overall quality of the entire portfolio.

6.4 Contract and Award Method Selection

After the evaluation of the different portfolio scenarios and the choice of a particular one the owner/client has to decide on a contract and award method for the projects, which will be procured instantly. The contract and award method for projects, which will be procured later, should be selected shortly before the procurement process starts in order to best assess the environment of the project.

6.4.1 Contract Selection

The selection of the contract should be based on an evaluation and fair allocation of the different risks inherent in a project. As already noted in section 5.4.3 different risks are involved during the procurement. Very often financial risk is the predominant risk from the owner's/client's point of view. Therefore, the choice of a contract method often depends on the ability to assess the risk, allocate it, and ensure a proper management of the risks by the responsible entity.

It has to be noted that a combination of different contract methods for different parts of a project is possible in order to best allocate the different risks on the involved entities.

6.4.2 Award Method Selection

The selection of the award method should be based on an evaluation of the project's scope concerning its perception as a commodity or a service. As already described in section 5.4.4 of this thesis a decision about the owner's/client's needs will lead to a certain recognition of the work. The more the project's important work is a commodity the more an award of the contract based on price is imaginable. If the work is perceived to be a service an award based on qualifications is advantageous.

After the use of the proposed methodology it is important that the owner/client recognizes that this process needs to be followed during every planning period in order to be able to improve the quality of the portfolio noticeable in the long-term. This includes the review of the decisions made during the last period and the review of the implementation of the chosen strategy. In addition, the projects of the chosen configuration, which have not yet been procured, need to be reconsidered and the decision about procuring the projects either approved or revised. This leads to a new start of the whole process in every period with the inclusion of these projects in addition to new projects.

6.5 Conclusion

6.5.1 Project and Procurement Method Selection Process

During the course of this thesis, it was tried to modify and extend an existing methodology developed by Gordon (1991, 1994) for providing the owner/client assistance in choosing appropriate procurement methods for different projects and in deciding about the combination of projects, the employed delivery method, and the timing and duration in

order to meet the demand for an improvement in the quality of the portfolio under the resource constraint.

This methodology tries to best allocate the limited amount of capital on a wise combination of projects. This demands for an understanding that the quality of the portfolio is directly influenced by the choice of the projects and their timing, duration, and financing and delivery strategy.

In this context, the owner/client must first realize the importance of the portfolio. Furthermore, a goal for the collection of assets needs to be defined by the owner/client. In addition, it is necessary for the owner/client to understand the different financing strategies, the source of the insufficiency of capital, and the issues, which can help in overcoming this capital constraint. In addition, the owner/client has to understand the different delivery method processes in order to take full advantage of them. At last, the owner/client has to understand the various components of the proposed projects in order to be able to fully benefit from the chosen process.

Figure 6-2 describes the process of choosing an appropriate delivery method in consideration of the different drivers and characteristics of the project, evaluating the financial viability of the different delivery methods for a project, preparing different configurations of projects for the portfolio based on the available resources, choosing a configuration after the portfolio driver analysis, and choosing an appropriate contracting and award method for the chosen projects.

This methodology should be applied every time decisions about procuring projects and spending money are made. In connection with a portfolio these decisions need to be made over and over again. It is a continuous and open process. Some projects are delivered, others are deferred, and again others are added over time.

Therefore, the evaluation should be repeated and decisions should be revised as the starting point for decisions changes as soon as one was attained.

Figure 6-2 Project and Procurement Method Selection Process

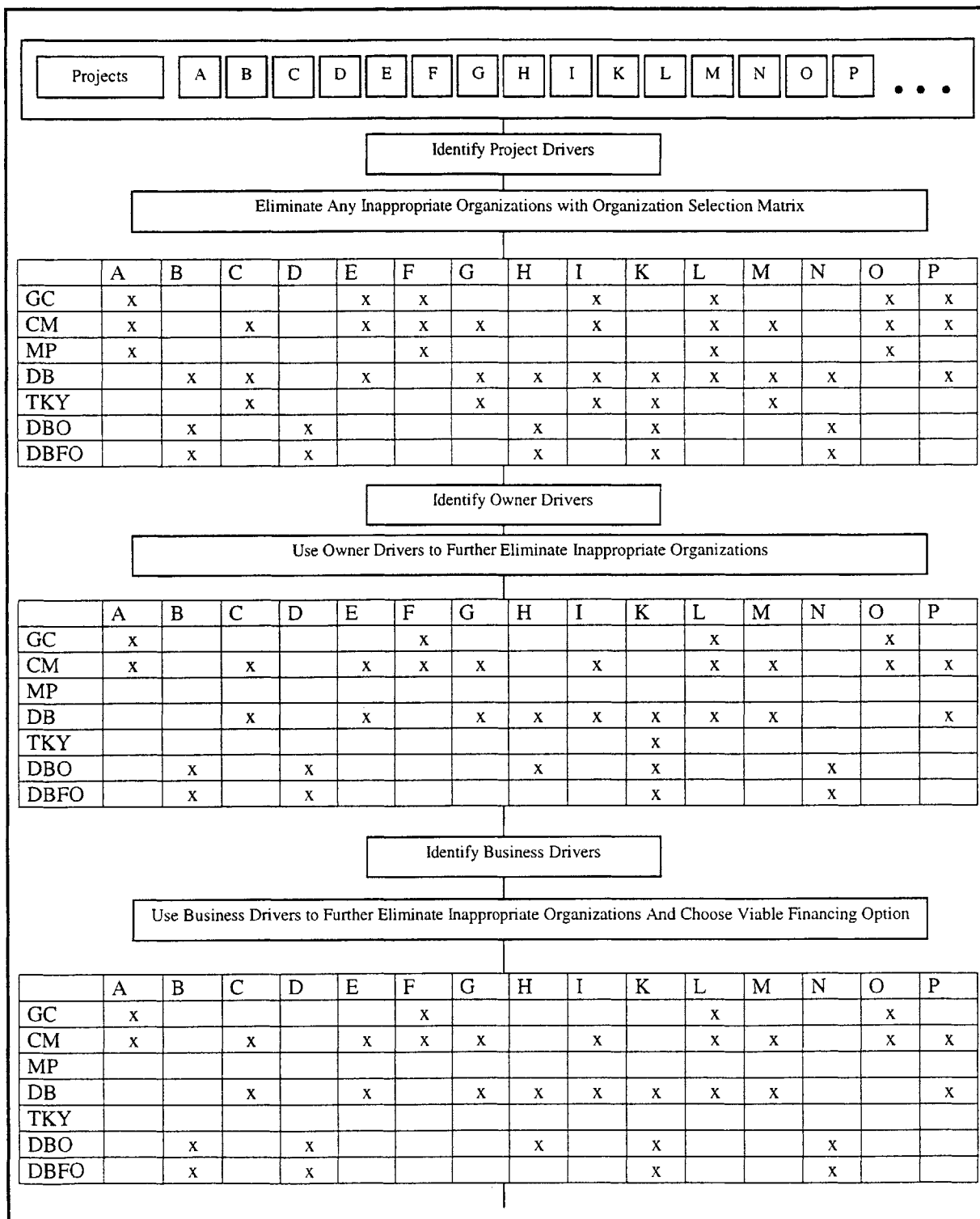
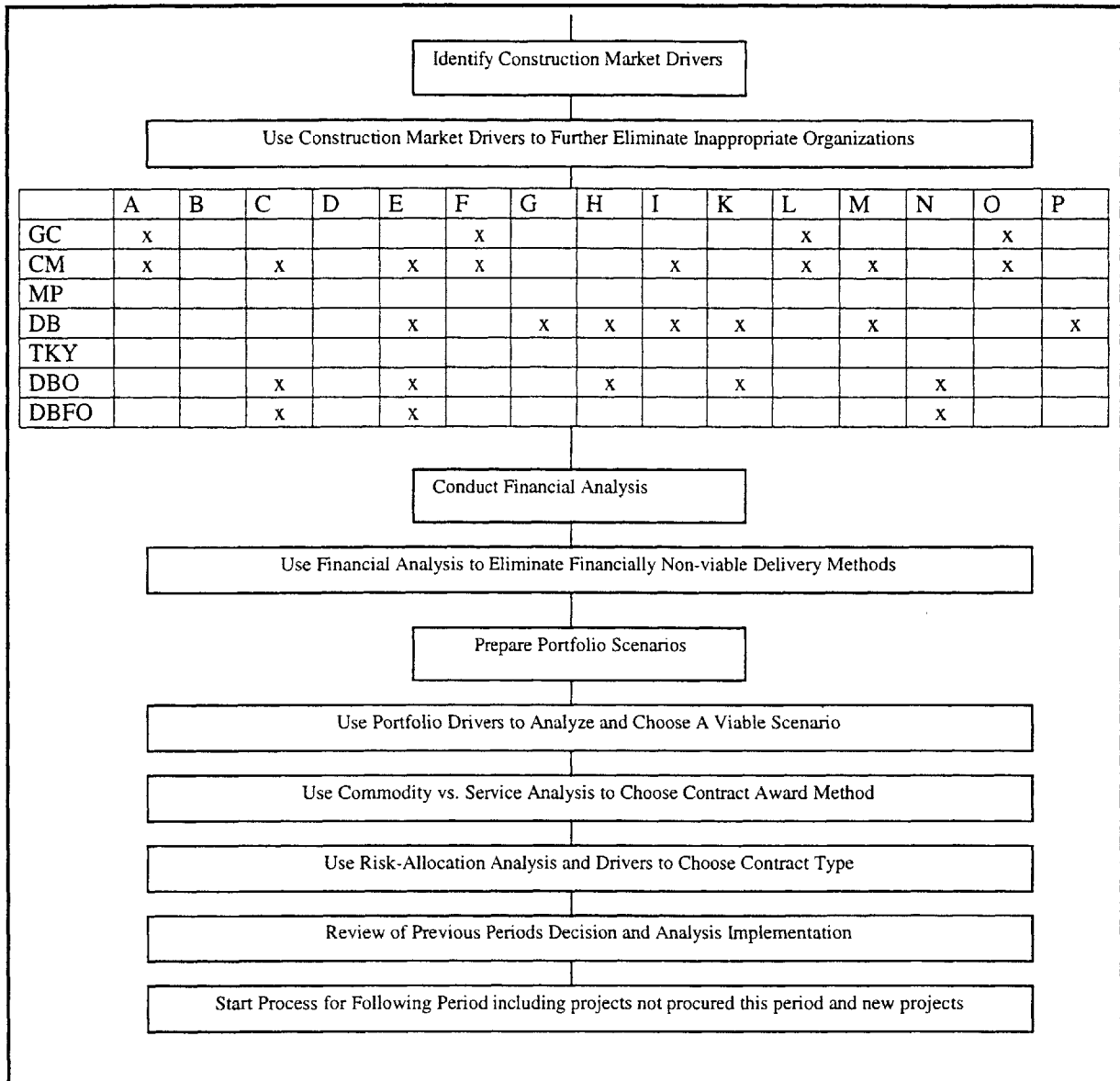


Figure 6-2 Cont'd



The owner/client has to recognize this in order to reach the goal of producing the greatest benefit at the known resource constraint.

During the process itself, decisions can be revised if found to be necessary. It is not a fixed process rather it is a process, in which different options should be evaluated in order to be able to judge what the best option is.

The method consists of three parts: (1) eliminating inappropriate delivery methods and analyzing the financial viability of the remaining procurement methods, and (2) choosing a viable combination of projects to improve the quality of the portfolio, and (3) choosing an appropriate contract and award method.

During the whole process it is essential that the owner/client is aware of the portfolio and is able to evaluate the consequences of his decision. In addition, by choosing an appropriate financing strategy and delivery method the cost and time performance and the quality level can be improved.

By using this methodology in connection with the new project life cycle (see section 1.2) the owner/client should be able to offer himself and every entity and individual involved and influenced a collection of assets, which best serves everybody's needs.

6.5.2 Developments in the Future

It should be the owner's/client's objective to include the developed methodology into his considerations concerning his portfolio. Furthermore, the owner/client has to recognize that different possibilities are open to him now and will be even more advantageous and easy to handle in the future.

An example is the incorporation of Information Technology during the whole process. This is already being implemented in the large scale only on few projects. Owners/clients as well as contractors are still skeptical towards this innovation. So far only few examples

exist, which can show the success of its use. But the owner/client and the involved entities have to understand that this technology offers them the opportunity to further reduce costs and time to finish as well as improve the quality of the project and the service to the owner/client. By connecting the different parties over the Internet the time of communication and transferring data can be reduced dramatically. This does not only save time but also cost.

The implementation of information technology is an excellent start for future developments. But this definitely demands for working in a team as well. If a project team with members of every entity involved is formed, a positive work environment can be established in which it is easier to communicate the expectations of the owner/client, the definition and understanding of the work's scope, and the complexity of the job.

Furthermore, the understanding of the processes included in procuring a project will improve. This will result in a more appropriate choice of the project and its financing and delivery strategy. The skepticism towards the alternative delivery strategies will hopefully decrease so that the owner/client can benefit from the differences of the delivery methods.

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